KONGSBERG

# Seapath® 320

## Technical Description

# About this document

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| | | | | |

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# Abbreviations

| | |
|---|---|
| AP | Aft Perpendicular. The vertical intersection of the design waterline at the stern, alternatively the centreline of the rudder stock. |
| BL | Base Line. Is the same as the keel for a vessel with horizontal keel line. |
| C/A | Coarse/Acquisition |
| CEP | Circular Error Probability |
| CG | Centre of gravity. The mass centre of a vessel. This is normally the location with least linear acceleration, and hence the best location for measurements of roll and pitch. |
| CL | Centre Line. Is the longitudinal axis along the centre of the ship |
| DGLONASS | Differential GLONASS |
| DGNSS | Differential Global Navigation Satellite System |
| DGPS | Differential GPS |
| ED50 | European Datum of 1950 |
| EGNOS | European Geostationary Navigation Overlay System (SBAS-Europe) |
| EPE | Estimated Position Error |
| GLONASS | Global Navigation Satellite System. A Russian system |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System. The American NAVSTAR system. |
| GPS Time | The time in the GPS system. The GPS time is within UTC time ±180 nsec (95 per cent) plus leap second |
| GUI | Graphical User Interface |
| HMI | Human Machine Interface |
| HP | High Precision |
| IALA | International Association of Lighthouse Authorities |
| IMU | Inertial Measurement Unit |
| LED | Light Emitting Diode |
| LGND | Logic Ground |
| LOA | Length OverAll |
| MMSI | Maritime Mobile Service Identity |
| MP | Monitoring Point |

| | |
|---|---|
| MRU 5 | Motion Reference Unit, model 5. This is the IMU within the Seapath measuring dynamic linear motion and attitude. A MRU consists of gyros and accelerometers. |
| MSAS | Multifunctional transport Satellite-based Augmentation System (SBAS-Japan) |
| NAD27 | North American Datum of 1927 |
| NMEA | National Marine Electronics Association. NMEA 0183 is a standard for interchange of information between navigation equipment. |
| NRP | Navigation Reference Point. The reference point for all measurements in Seapath. The recommended used NR is the vessel CG or rotation centre. |
| PGND | Power Ground |
| PPS | Pulse Per Second |
| PRN | Pseudorandom Noise |
| PSS | Physical Shore Station |
| RAIM | Receiver Autonomous Integrity Monitoring |
| RMS | Root Mean Square |
| RTCM | Radio Technical Commission of Maritime Services |
| SA | Selective Availability |
| SBAS | Satellite Based Augmentation System |
| SL | Speed Along Ship |
| SNR | Signal/Noise Ratio |
| SOG | Speed Over Ground |
| SRRD | Seatex Rescue and Restore Disk |
| ST | Speed Transverse Ship |
| SW | Software |
| UTC | Universal Time Co-ordinated. This is the official time in the world and has replaced GMT (Greenwich Mean Time) as the official time. |
| UTM | Universal Transverse Mercator |
| WAAS | Wide Area Augmentation System (SBAS-USA/Canada) |
| WEEE | Waste Electrical and Electronic Equipment |
| WGS84 | World Geodetic System of 1984 |

# Terminology

| | |
|---|---|
| Alignment | Is the process of adjusting the current internal navigation frame in the instrument to the true external frame. |
| Antenna bracket | Is the arrangement for mounting the GPS antennas. |
| Antenna holder | Is the arrangement on board the vessel for mounting the antenna bracket to. |
| Attitude | The orientation relative to the vertical axis of a vehicle. Heading is not included. If heading is included the word "orientation" is used for the vehicle. |
| Beam | The maximum width of the vessel at Main Deck level (B. mld). |
| GPS Time | The time in the GPS system. The GPS time is within UTC time ±180 nsec (95 per cent) plus leap second. |
| Heading | The direction of the main axis (bow direction) of the vehicle as opposed to course, which is the direction of motion of the vehicle. Yaw angle as defined here is the same as heading. |
| Heave | The vertical dynamic motion of a vehicle and defined positive down. Heave position and velocity are dynamic motion variables oscillating around a mean value, typically zero. |
| Height | The height in the Seapath product is defined as the vertical position relative to the WGS84 datum (rotational ellipsoid). |
| Host system | In this manual defined as Navigation computers, Dynamic Positioning Systems, etc., receiving data from Seapath. |
| Origin | The zero point in the coordinate system. The origin is the intersection point between AP, BL and CL. |
| P-axis | This axis is fixed in the vehicle, and points in the starboard direction horizontally when the roll angle is zero. Positive rotation about this axis is bow of the vehicle up. |
| Pitch | A rotation about the pitch axis is positive when the bow moves up. Normally, pitch means the dynamic pitch angle motions. |
| R-axis | This axis is fixed in the vehicle, and points in the forward direction horizontally when the pitch angle is zero. Positive rotation about this axis is starboard side of the vehicle down. |
| Roll | A rotation about the roll axis is positive when starboard side of the vehicle moves down. Normally, roll means the dynamic roll angle motion. |
| Starboard | When looking in the bow direction of a vehicle, this is the right hand side of the vehicle. |

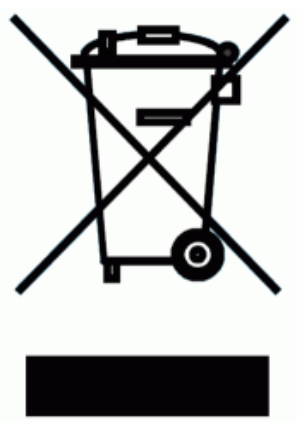
| | |
|---|---|
| Surge | The along ship dynamic motion of a vehicle and defined positive forward. |
| Sway | The athwart ship dynamic motion of a vehicle and defined positive starboard. |
| Y-axis | This axis is fixed in the vehicle and points in the downward direction when the vehicle is aligned horizontally. Positive rotation about this axis is turning the bow of the vehicle to starboard. |
| Yaw | A rotation about the vertical axis is positive when turning Eastward (Clockwise) when the vehicle cruises in North direction. Normally, yaw means the dynamic yaw motion. |

# References

[1] M300-62, Seapath 320 Installation Manual
[2] NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 3.00
[3] RTCM Recommended Standards for Differential Navstar GPS Services, Version 2.3

# Health, environment and safety warnings

All electrical and electronic components have to be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or local authorities. The correct disposal and separate collection of your old appliance will help prevent potential negative consequences for the environment and human health. It is a precondition for reuse and recycling of used electrical and electronic equipment. For more detailed information about disposal of your old appliance, please contact your local authorities or waste disposal service.



Until further notice is given regarding reuse, disassembly or disposal, the equipment at end-of-life, could be returned to Kongsberg Seatex AS if there is no local WEEE collection.

The equipment is marked with this pictogram.

# Restrictions in export

Export of the MRU 5 component within the Seapath product to other countries than EU countries or Argentina, Australia, Canada, Iceland, Japan, New Zealand, Switzerland, South-Korea, Turkey, Ukraine and USA, requires an export license.

Notice to Importer: The MRU product specified in this document has been shipped from Norway in accordance with The Ministry of Foreign Affairs' Official Notification on Export Control and may be subject to restrictions if re-exported from your country.

# Restrictions in guarantee

The liability of Kongsberg Seatex is limited to repair of the Seapath system only under the given terms and conditions stated in the sales documents. Consequential damages such as customer's loss of profit or damage to other systems traceable back to Seapath malfunctions are excluded. The warranty does not cover malfunctions of the Seapath resulting from the following conditions:

1 The MRU is not shipped in the original transport box.

2 The MRU has been exposed to extreme shock and vibrations.

3 The MRU housing has been opened by the customer in an attempt to carry out repair work.

4 Over-voltage or incorrect power connection.

5 Shorting of GNSS antenna cable during operation of the Seapath systems.

# Restrictions in use

The Seapath function is based on GNSS signals and requires free sight to the sky, minimum four visible satellites, PDOP value less than 6 and otherwise normal conditions to operate. It is designed for use on board marine surface operated vehicles with linear acceleration less than ±30 $m/s^2$ (±3g) and an angular rate range less than ±150°/s.

Only relative dynamic heave position is calculated.

# 1 PRODUCT DESCRIPTION

The Seapath 320 is a positioning, attitude and heading sensor. The product combines inertial technology together with GPS and GLONASS satellite signals. Core components in the product are the MRU 5 inertial sensor, the two combined GPS/GLONASS receivers, the Processing and HMI Unit.

## 1.1 Purpose and application

The product is developed specifically for hydrographic and other high precision applications where heading, position, roll, pitch, heave and timing are critical measurements.

The Seapath 320 offers the best possible combination of GNSS signals and inertial measurements for demanding operations in challenging environments. The possibility to use GLONASS in addition to the GPS satellites significantly increases satellite availability, provides robust integrity monitoring and results in more precise solutions, particularly in highly obstructed environments.

The combination of GNSS signals and inertial data enables much better performance than each of the signals alone, with a high output data rate (up to 200 Hz), zero delay on output data, data available in up to eight different monitoring points and a total of eight configurable serial lines and Ethernet ports.

This Seapath product is a two-module solution with a Processing and an HMI Unit connected via Ethernet. The Processing Unit runs all critical computations independent of the user interface on the HMI Unit to ensure continuous and reliable operation. Several HMI Units can be connected to the same Processing Unit in a networked architecture. The HMI Units present the vessel motion in a simple and easy-to-understand format to ensure that the decision making based on the available data is as efficient as possible.

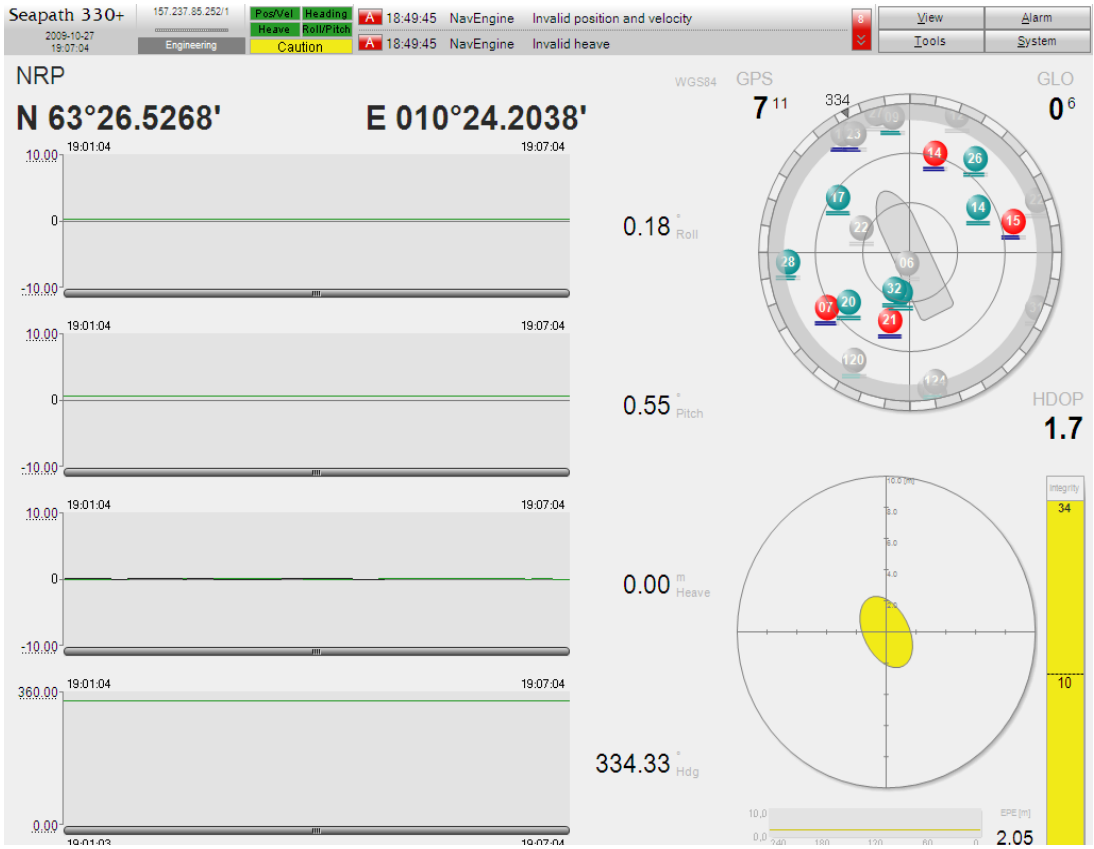



*Figure 1 Typical information shown to the user*

## 1.2 System components

The Seapath 320 comprises the following main components, which are physically separated:

- A Processing Unit for I/O and calculations.
- An HMI Unit with MONITOR, keyboard and PC mouse.
- An MRU 5 inertial sensor.
- An MRU wall mounting bracket.
- An MRU junction box with three metres of cable for interfacing to the MRU.
- An Antenna Bracket with two GNSS antennas.

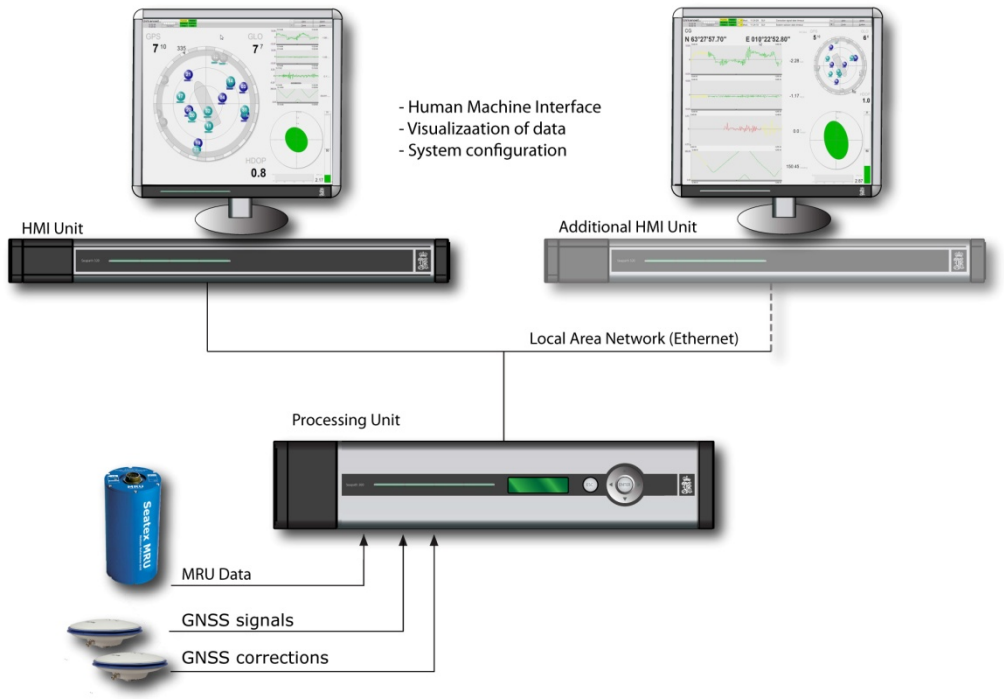



*Figure 2 System architecture*

### 1.2.1 The Processing Unit

The Processing Unit is designed to fit standard 19-inch racks and is typically installed on the bridge or in the instrument room. The Processing Unit comprises the following main parts:

- Hard disk
- Serial I/O board, Ethernet and computer main board
- Power supply
- Two GNSS receivers

The power on/off switch, LAN port and USB connection are located under the lid on the left part of the front panel.

*Figure 3 Front panel of Processing Unit*

The rear panel of the Processing Unit contains communication interface ports for interfacing to external sensors. These ports are individually galvanically isolated.

*Figure 4 Rear panel of Processing Unit*

### 1.2.2 The HMI Unit

The HMI Unit is designed to fit 19-inch racks and is typically installed on the bridge or in the instrument room. The 1U-height HMI Unit comprises the following main parts:

- Flash disk
- Serial I/O board, Ethernet and computer main board
- Power supply

The power on/off switch and USB connection are located under the lid on the left part of the front panel.

*Figure 5 Front panel of HMI Unit*

*Figure 6 Rear panel of HMI Unit*

### 1.2.3 The MRU 5

The Seatex MRU 5 is specifically designed for motion measurements in marine applications. The unit incorporates 3-axis sensors for linear acceleration and angular rate, along with complete signal processing electronics and power supply. The MRU 5 outputs absolute roll and pitch. Dynamic acceleration in the MRU axes direction as well as velocity and relative position, are also provided. The MRU achieves high reliability by using sensors with no rotational or mechanical wear out parts.

*Figure 7 The MRU 5*

When the MRU is used within the Seapath product, only raw angular rate and linear acceleration data is output from the unit. All processing of these signals to roll, pitch, heave and velocity measurements is performed in the Kalman filter in the Processing Unit. The analog output channels from the MRU, as indicated in Figure 8, are therefore not used when the MRU is used within the Seapath product.

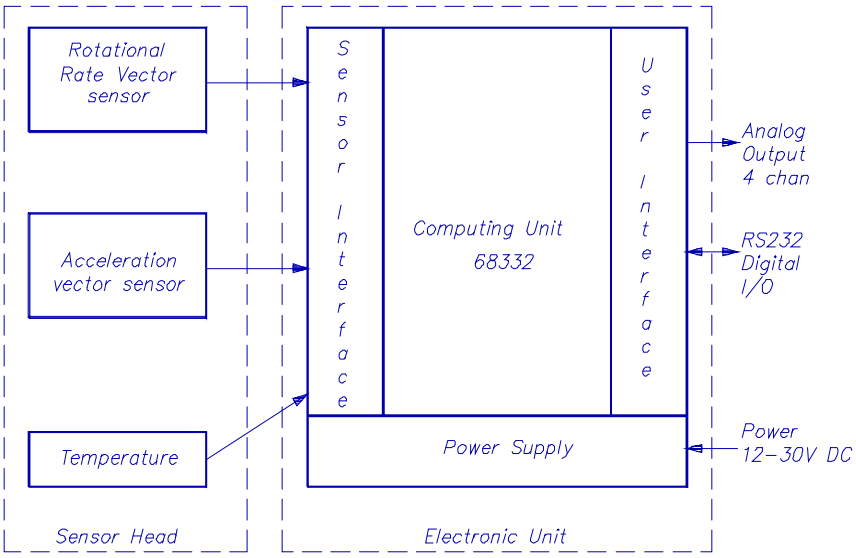



*Figure 8 MRU 5 functional modules*

The interior of the MRU is divided into two sub-assemblies consisting of an electronic unit and a sensor unit. The electronic unit consists of plug-in circular multi-layer boards. Extensive use is made of surface mounted components. The unit is divided into nine separate mechanical parts, which may be exchanged very quickly by plug in boards when the housing cylinder has been removed. The housing cylinder should, however, not be removed by anyone else than Kongsberg Seatex.

The MRU is integrated in Seapath, and all digital data are routed through the Processing Unit.

### 1.2.4 The GNSS antennas and antenna bracket

In a standard Seapath delivery, the Antenna Bracket is 2.5 metres. The Antenna Bracket is delivered in aluminium. However, maximum heading accuracy is achieved with 4-metre antenna separation. For antenna separations greater than 2.5 metres it is recommended to mount each antenna separately on a rigid structure.

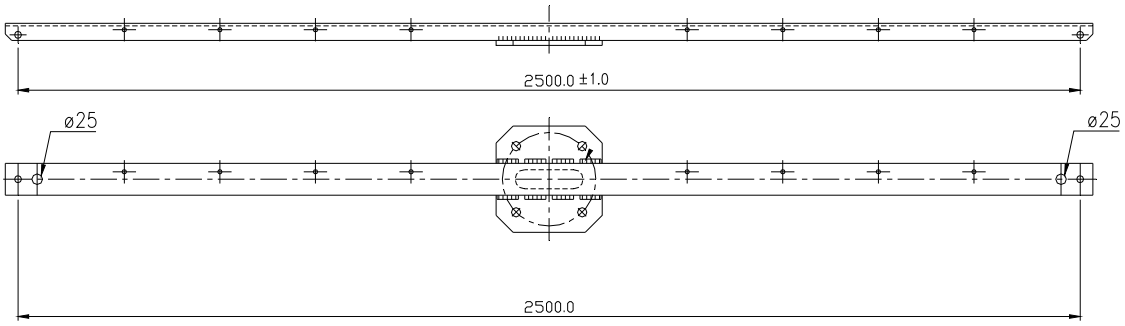



*Figure 9 Antenna Bracket*

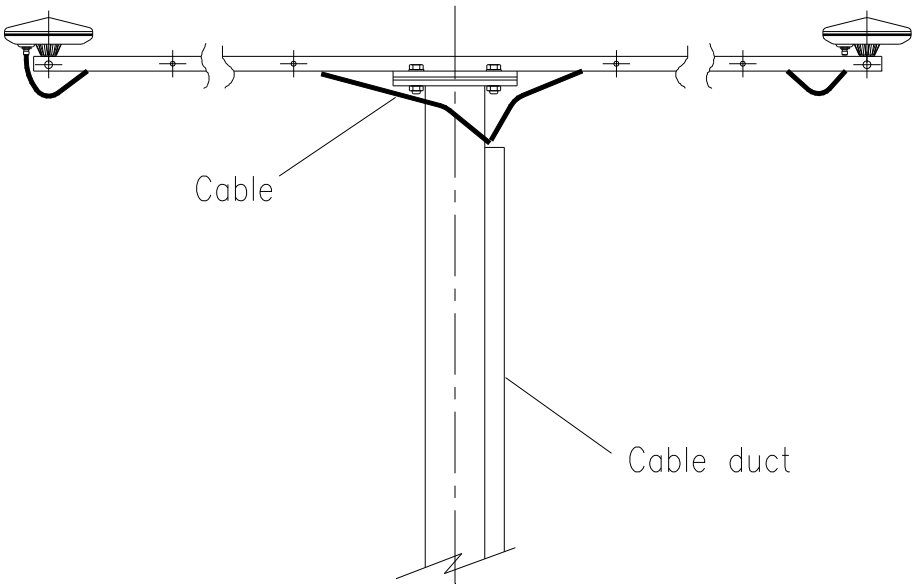



*Figure 10 Side view of GNSS antenna installation*

## 1.3 Networked architecture

The Navigation Engine runs all critical computations independent of the HMI Unit to ensure continuous and reliable operation. Navigation Engine runs in a safe mode protected from unintended user operations. Several HMI Units can be connected to the same Navigation Engine in a networked architecture.

# 2 TECHNICAL SPECIFICATIONS

## 2.1 Performance data

Roll and pitch accuracy for ±5° amplitude ..... 0.02° RMS (*)

Heading accuracy with 2.5 metre antenna baseline ..... 0.075° RMS

Heading accuracy with 4 metre antenna baseline ..... 0.05° RMS

Scale factor error in roll, pitch and heading ..... 0.08 % RMS

Heave accuracy ..... 5 cm or 5 % whichever is highest

Heave motion periods (real-time output) ..... 0 to 20 seconds

Heave motion periods (delayed signal, PFreeHeave®) ..... 0 to 50 seconds

Position accuracy with DGPS/GLONASS ..... 0.5 m RMS or 1 m 95 % CEP

Position accuracy with SBAS ..... 0.5 m RMS or 1 m 95 % CEP

Position accuracy with RTK (floating ambiguity mode) .....
..... 0.15 m RMS or 0.35 m 95 % CEP

Velocity accuracy ..... 0.03 m/s RMS or 0.07 m/s 95 % CEP

The performance figures are valid with a minimum of four visible satellites, HDOP less than 2.5, PDOP less than 6, high quality DGPS corrections, correctly measured offsets and otherwise normal conditions. Excessive multipath, GNSS signal obstructions or interference may reduce the performance.

## 2.2 Physical dimensions

### 2.2.1 Processing Unit

Height ..... 88.1 mm (2U)

Width ..... 485 mm (19")

Depth ..... Min 325 mm (excluding connectors on rear panel) and max 412 mm

Weight ..... 5.4 kg

Colour ..... Front anodized natural

### 2.2.2 HMI Unit

Height ..... 43.65 mm (1U)

Width ..... 485 mm (19")

Depth ..... Min 325 mm (excluding connectors on rear panel) and max 405 mm

Weight .....3.8 kg
Colour ..... Front anodized natural

### 2.2.3 Monitor, 17-inch LCD

Type .....Samsung SyncMaster 710n
Width ..... 380 mm
Height ..... 383 mm
Depth ..... 170 mm
Weight .....3.8 kg
Colour .....Black and silver

### 2.2.4 MRU Unit

Type .....MRU 5
Height ..... 204 mm (8.032")
Diameter ..... 105 mm (4.134")
Weight .....2.5 kg
Colour ..... Blue
Connector .....Souriau 851-36RG 16-26S50 (MIL. spec.)

### 2.2.5 MRU Wall Mounting Bracket

Type ..... MRU-M-MB3
Length ..... 265 mm
Width ..... 119 mm
Height ..... 119 mm
Weight .....1.6 kg
Colour ..... Black
Material.....POM-H

### 2.2.6 MRU Junction Box

Type ..... MRU-E-JB1
Length ..... 226 mm
Width ..... 126 mm
Height ..... 90 mm
Weight .....2.0 kg

Colour ..... Black
Material ..... Aluminium
Enclosure protection ..... IP-65

### 2.2.7 Antenna Bracket

Type ..... M320-21
Length ..... 2560 mm
Width ..... 75 mm
Height ..... 40 mm
Weight ..... 6.6 kg
Colour ..... Grey RAL 7035

### 2.2.8 GNSS antenna

Type ..... Novatel GPS-702-GG
Height ..... 69.1 mm
Diameter ..... 185 mm
Weight ..... 0.5 kg
Colour ..... White

The GNSS antenna is a right-hand circular polarised L-band antenna with an integral low-noise amplifier. The internal thread is $^{5}/_{8}$ x 11 (standard marine mount).

### 2.2.9 Cabinet

Height ..... 390 mm
Depth ..... 600 mm
Width ..... 553 mm
Depth with keyboard extended ..... 770 mm
Recommended free space from wall ..... 20 mm

## 2.3 Power

### 2.3.1 Processing Unit

Voltage ..... 100 - 240 V AC, 50/60 Hz

Power consumption ..... Max. 75 W[1]
Batteries ..... None, connection to UPS recommended

### 2.3.2 HMI Unit

Voltage ..... 100 - 240 V AC, 50/60 Hz
Power consumption ..... Max. 40 W
Batteries ..... None, connection to UPS recommended

### 2.3.3 Monitor, 17-inch LCD

Voltage ..... 100 to 240 V AC, 50/60 Hz
Power consumption ..... 23 Watts (typical)

### 2.3.4 MRU

Voltage ..... 24 V DC, from Processing Unit

### 2.3.5 GNSS antenna

Voltage ..... 5 V DC, from Processing Unit

## 2.4 Environmental

### 2.4.1 Processing Unit

Enclosure material ..... Aluminium
Operating temperature range ..... -15 °C to +55 °C[2]
Recommended operating temperature ..... Room temperature (+20 °C)
Storage temperature ..... -20 °C to +70 °C
Operating humidity ..... Max. 95 % non-condensing
Storage humidity ..... Less than 55 %
Ingress protection front ..... IP 42
Ingress protection rear ..... IP 21

[1] With MRU connected.
[2] Operating temperature up to +55 ºC for 10 hours.

### 2.4.2 HMI Unit

Enclosure material ..... Aluminium
Operating temperature range ..... -15 °C to +55 °C[3]
Recommended operating temperature ..... Room temperature (+20 °C)
Storage temperature ..... -20 °C to +70 °C
Operating humidity ..... Max. 95 % non-condensing
Storage humidity ..... Less than 55 %
Ingress protection front ..... IP 42
Ingress protection rear ..... IP 21

### 2.4.3 Monitor, 17-inch LCD

Operating temperature range ..... 5 to +40 °C
Relative humidity ..... 20 to 80 %

### 2.4.4 MRU Unit

Enclosure material ..... Anodised aluminium
Enclosure protection ..... IP-66
Operating temperature range ..... -5 to +55 °C
Operating humidity (max) ..... Sealed, no limit
Storage temperature range ..... -20 to +70 °C
Storage humidity ..... Sealed, no limit
Max allowed vibration operational (10 – 2000 Hz continuous) ..... 0.5 $m/s^2$
Max allowed vibration non-operational (0 – 200 Hz continuous) ..... 20 $m/s^2$
Max shock non-operational (10 ms peak) ..... 1000 $m/s^2$

### 2.4.5 GNSS antenna

Operating temperature range ..... -40 °C to +85 °C
Ingress protection ..... IP X6 and IP X7

[3] Operating temperature up to +55 ºC for 10 hours.

## 2.5 External interfaces

### 2.5.1 Processing Unit

Serial ports.....6 non-dedicated isolated ports, RS-232 or RS-422
.....Isolated Com1 and Com2, 9 pin DSub, RS-232 or RS-422
Baud rate.....Up to 115 200 bytes/sec
LAN.....4 Ethernet ports
USB .....3 ports, 1 in front and 2 in rear
Data output rate .....Up to 200 Hz
Data delay..... All data in real-time (0 ms) plus transmission delay
1PPS signal accuracy.....220 nsec
Analog outputs.....3 user configurable channels, ±10 Volts

### 2.5.2 HMI Unit

USB .....3 ports, 1 in front and 2 in rear
LAN..... 1 Ethernet port in rear

### 2.5.3 MRU Unit

Serial ports.....1 RS-232 or RS-422
Digital output variables ..... Max. 16
Data output rates.....Max. 100 Hz
Timing .....< 1 ms

## 2.6 Product safety

### 2.6.1 Processing Unit

Electrical safety ..... IEC 60950-1/EN60950-1
Electromagnetic compatibility (immunity/radiation).....IEC 60945/EN60945
Vibration.....IEC 60945/EN60945

## 2.7 Radio frequencies

### 2.7.1 GNSS antenna

L1 ..... 1588.5 ± 23.0 MHz

L2 ..... 1236.0 ± 18.3 MHz

LNA gain (typical) ..... 27 dB

### 2.7.2 GNSS receiver

GPS L1 ..... 1575.42 MHz

Glonass L1 .....1602.0 MHz for Fk=0 where k=(-7 to +13) channel spacing 562.5kHz

## 2.8 Data outputs

### 2.8.1 Processing Unit

Message format ..... NMEA 0183 v. 3.0, Proprietary

Message types .....NMEA 0183 ZDA, GGA, GLL, VTG, HDT, GST, GSA and GRS

..... NMEA proprietary PSXN, 20, PSXN, 21, PSXN, 22 and PSXN, 23

..... Simrad EM1000 (Simrad EM950 and EM1000 compatible)

..... Seapath binary format 3

..... Simrad EM3000 (Simrad EM3000, EM300 and HiPap compatible)

..... Calibration format

..... Echo sounder format

.....RD Instrument ADCP proprietary NMEA format, "PRDID"

..... Seapath binary format 11

..... Lehmkuhl gyro repeater format

..... 1PPS time tag, NMEA ZDA message

..... 1PPS time tag, Trimble compatible messages

.....Atlas Fansweep format

..... Echo sounder format 18, TSS1

..... Seapath binary format 23

..... PFreeHeave format

## 2.9 Data inputs

### 2.9.1 Processing Unit

DGPS corrections ..... RTCM-SC104 v. 2.2 and 2.3
..... Trimble CMR
DGLONASS corrections ..... RTCM-SC104 v. 2.2
Gyro compass ..... NMEA 0183 HEHDT and HEHRC
..... Robertson LR22 BCD format

## 2.10 Compass safe distance

### 2.10.1 Processing Unit

Standard compass (mounted in 6U cabinet) ..... 2.6 m

*Note* *If the Processing Unit is not marked with a compass safe distance label, the unit shall be placed five metres from both the steering compass and the standard compass.*

## 2.11 Cables

### 2.11.1 MRU cable

Type ..... MRU-E-CS1
..... Heavy duty screened, 14 x 2 x 0.25 $mm^2$
Length ..... 3 m
Diameter ..... 13.5 mm
Weight ..... 0.27 kg/m
Flame retardation ..... IEC 332-1
Insulation ..... ETFE
Screen ..... Cu-braid

### 2.11.2 Processing Unit to MRU Junction Box cable

Type ..... LAMAC, 4 x 2 x 0.5 $mm^2$
Maximum length ..... 100 m
Diameter ..... 10 mm

Flame retardation.....IEC 332-3/A

### 2.11.3 GNSS antenna cables (Coax)

Type..... ½"-Superflex 50 BHF

Attenuation .....14 dB/100 m (at 1.6 GHz)

Maximum length (each cable).....100 m

Diameter ..... 13.2 mm

Minimum bend radius..... 32 mm

Flame retardation.....CATV, UL1581, IEC 332-3, IEEE383

Coax connectors ..... Huber+Suhner 11 N-50-9-9

If the antenna cables are not delivered by Kongsberg Seatex, make sure that the cables meet the following electrical specifications:

| | |
|---|---|
| Insertion loss (max.) | 15 dB (at 1.6 GHz) |
| Characteristic impedance | 50 Ohm (nominal) |
| DC resistance (max.) | 0.5 Ohm ground braid and centre conductor |

*Table 1 GNSS antenna cable specification*

The antenna connectors on the Processing Unit are of N-type male. On the GNSS antennas both TNC-type female and N-type female are available. Optionally, an interconnection cable for transfer of connector type from TNC on the antenna to N-type on the antenna cable, can be delivered.

## 2.12 Interfaces Processing Unit

The rear panel of the Processing Unit contains communication interface ports for interfacing to external equipment. In addition, a USB and a LAN port are situated at the front together with the power switch.

*Figure 11 Rear panel of Processing Unit without chord anchorage*

| **Connector** | **Type** | **Connected to** |
|---|---|---|
| GNSS 1 | N connector 50 Ohm female | GNSS antenna |
| GNSS 2 | N connector 50 Ohm female | GNSS antenna |
| IALA | N connector 50 Ohm female | Not in use |
| LAN 2 | RJ-45 | User configurable |
| USB 2 | USB | User configurable |
| USB 3 | USB | User configurable |
| LAN 3 | RJ-45 | Not in use |
| LAN 4 | RJ-45 | User configurable |
| Mouse | PS/2 | Mouse |
| Keyboard | PS/2 | Keyboard |
| COM 1 | 9 pin DSub male, RS-232 | User configurable |
| COM 2 | 9 pin DSub male, RS-232 | User configurable |
| VGA | HD15 female | Monitor |
| COM 9 | 5 pins terminal, RS-232/422 | User configurable |
| COM 10 | 5 pins terminal, RS-232/422 | User configurable |
| COM 11 | 5 pins terminal, RS-232/422 | User configurable |
| COM 12 | 5 pins terminal, RS-232/422 | User configurable |
| COM 13 | 5 pins terminal, RS-232/422 | User configurable |
| COM 14 | 5 pins terminal, RS-232/422 | User configurable |

| Connector | Type | Connected to |
|---|---|---|
| ALARM | 3 pins terminal, relay | External alarm system |
| MRU | 10 pins terminal, RS-422 | MRU5 or MRU5+ |
| IMU | 10 pins terminal | Not in use |
| 1PPS | 6 pins terminal | External equipment |
| ANALOG OUT | 10 pins terminal | User configurable |
| ANALOG IN | 6 pins terminal | Not in use |
| 115/230VAC | Power | Input of 115/230VAC |

*Table 2 Connectors at rear of Processing Unit*

| Connector | Type | Connected to |
|---|---|---|
| LAN 1 | RJ-45 | User configurable |
| USB 1 | USB | User configurable |

*Table 3 Connectors at front of Processing Unit*

*Note* *All numbering of the pins on the terminals goes from left (no. 1) to right*

### 2.12.1 RS-422 A and B signal definition

According to the following standard the signal state definitions are:

- IEC 61162-1. The idle, marking, logical 1, OFF or stop bit states are defined by a negative voltage on line A with respect to line B. The active, spacing, logical 0, ON or start bit states are defined by a positive voltage on line A with respect to line B. It should be noted that the above A with respect to B levels are inverted from the voltage input/output requirements of standard UARTs and that many line drivers and receivers provide a logic inversion.

### 2.12.2 Pin layout

#### 2.12.2.1 COM 1 and 2

Com 1 and Com 2 at the rear of the Processing Unit are 9-pin DSub male and have the following pin layout.

| Pin no. | RS-232 | Pin no. | RS-232 |
|---|---|---|---|
| 1 | DCD1 | 6 | DSR1 |
| 2 | RXD1 | 7 | RTS1 |
| 3 | TXD1 | 8 | CTS1 |
| 4 | DTR1 | 9 | RI1 |
| 5 | GND | | |

*Table 4 Pin layout of Com 1 and Com 2*

#### 2.12.2.2 Connector board

The screw terminal pin layout on the connector board at the rear of the PU is described below.

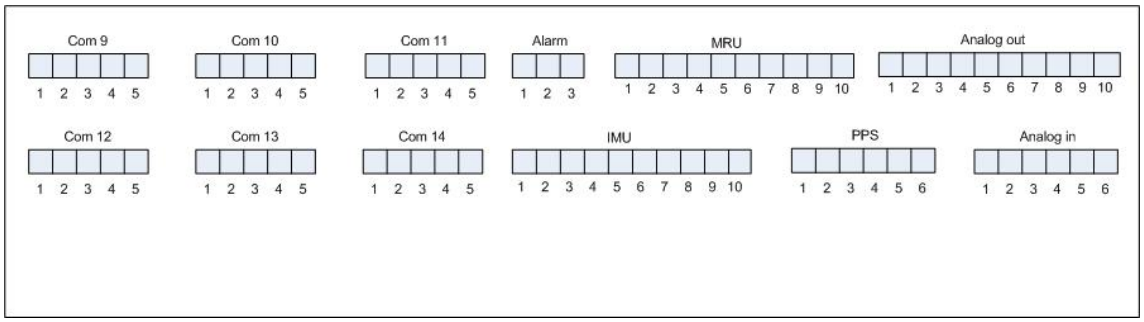



*Figure 12 Connector board*

#### Serial lines – Com 9 – Com 14

The system communicates with external equipment through the six RS-232 or RS-422 configurable serial input and output lines.

The configuration of serial lines and their default settings are:

| Pin no. | Signal | |
|---|---|---|
| | **RS-422** | **RS-232** |
| 1 | RX_A | CTS |
| 2 | RX_B | RX |
| 3 | GND | GND |
| 4 | TX_A | RTS |
| 5 | TX_B | TX |

*Table 5 Pin layout of Com 9 through Com 14*

### PPS signal

A 1 pulse-per-second (1PPS) signal synchronized with GNSS time is available from the 6 pin terminal at the rear of the Processing Unit. This RS-422 1PPS signal originates from the GNSS receiver within the Processing Unit. The 1PPS signal is buffered and fed to the terminal. The 1PPS signal is active high and has a pulse width of 10 ms. The 1PPS is generated exactly once every second with its rising edge synchronised to GPS time.

Compared to the Seapath 200 models which have a BNC connector, this Seapath model uses a serial signal. Pin no. 1 (TX_A) has a positive edge at the beginning of the pulse and pin no. 2 (TX_B) has a positive edge at the end of the pulse.

| Pin no. | Signal | Direction |
|---|---|---|
| 1 | 1PPS TX_A | Output |
| 2 | 1 PPS TX_B | Output |
| 3 | GND isolated | Output |
| 4 | GND isolated | Input |
| 5 | 1PPS RX_A | Input |
| 6 | 1PPS RX_B | Input |

*Table 6 Pin layout of PPS port*

Synchronized with this signal it is possible to output 1PPS time tag messages from Seapath. These messages are the 1PPS NMEA ZDA (format no. 13) or the Trimble compatible message (format no. 14).

→ *For description of the format for these messages, see the Seapath 320 Installation Manual.*

### Relay - alarm signal

The Processing Unit has a built-in alarm functionality and can be connected to an external alarm. An alarm will open the alarm relay, which can be used to trigger an external alarm. The external alarm can be connected to the Alarm 3 pin terminal.

| Pin no. | Signal |
|---|---|
| 1 | NC |
| 2 | Alarm_Com |
| 3 | Alarm_NO |

*Table 7 Pin layout of Alarm*

The diagram below shows how an external alarm can be connected to the Processing Unit ALARM terminal.

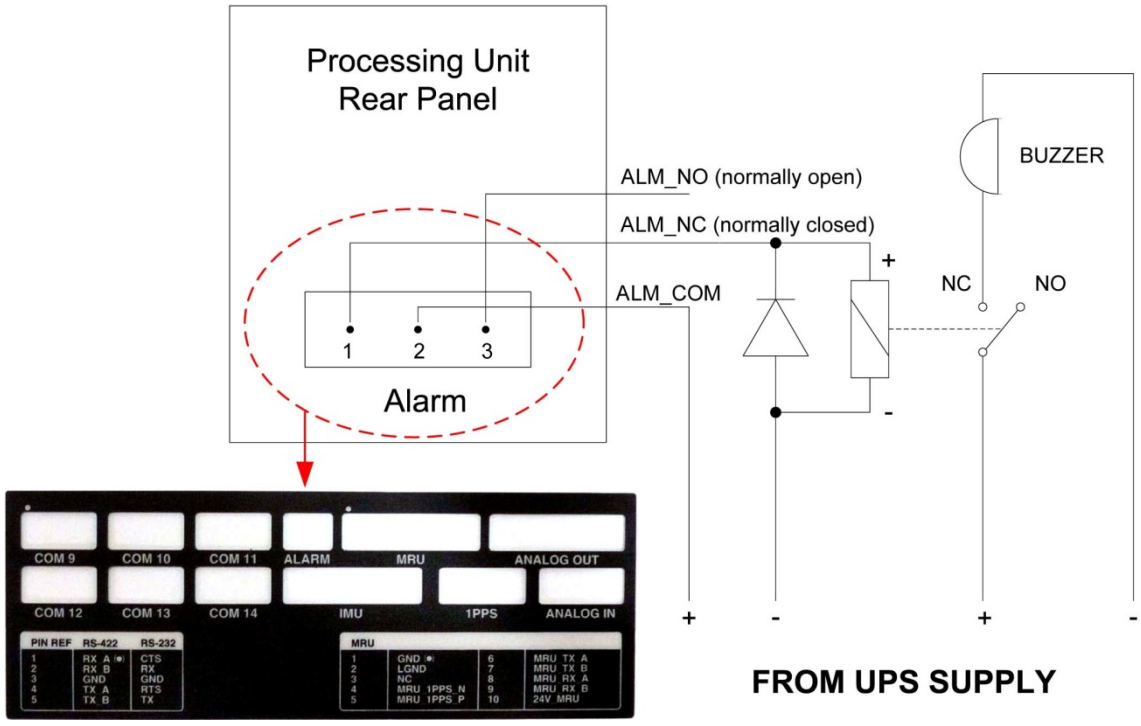



*Figure 13 External alarm connection diagram*

### Analog output

Three analog output channels are available on the Analog Out 10 pin terminal. The variables available for analog output are roll, pitch, heave and Datawell Hippy compatible roll and pitch signals. The selection of variable and channel properties is performed in the operator software.

The pin wiring for the analog outputs is as follows:

| Pin no. | Signal |
|---|---|
| 1 | GND_Isolated_DAC |
| 2 | Analog_Out_Ch2_N |
| 3 | Analog_Out_Ch2_P |
| 4 | GND_Isolated_DAC |
| 5 | Analog_Out_Ch1_N |
| 6 | Analog_Out_Ch1_P |
| 7 | GND_Isolated_DAC |
| 8 | Analog_Out_Ch0_N |
| 9 | Analog_Out_Ch0_P |
| 10 | GND_Isolated_DAC |

*Table 8 Pin layout of Analog Out*

### MRU

The MRU connector is used for power and interface to an MRU. Usually when an MRU is connected to a Processing Unit, a junction box is used to make the wiring easier.

The pin wiring for the MRU port is as follows:

| Pin no. | Signal |
|---|---|
| 1 | GND |
| 2 | LGND |
| 3 | NC |
| 4 | MRU_1PPS_N |
| 5 | XIN/MRU_1PPS_P |
| 6 | TX_A |
| 7 | TX_B |

| Pin no. | Signal |
|---|---|
| 8 | RX_A |
| 9 | RX_B |
| 10 | 24V_MRU |

*Table 9 Pin layout of MRU*

### IMU

The IMU terminal is not in use in this product.

### Analog in

This terminal is not in use in this product.

### Ethernet connection

The Processing Unit has the possibility to input and output data on individually configurable network ports. The format and update rate are configured for each port in the **NavEngine Configuration** view.

The Processing Unit has the following LAN and connection possibilities:

- **LAN 1 in the front**. This is primarily a service port and has less capacity (10/100 Mbps) that the other LANs. To connect this LAN to a network, a straight-through twisted pair (TP) cable with RJ-45 connectors must be used. A straight-through cable is one where the pins of one connector are connected to the same pins of the other connector. In special instances a crossover cable instead of a straight-through cable is needed, for example when connecting a Processing Unit to another Processing Unit. Below is the pin wiring for the different TP cables:

| Straight-through | | | |
|---|---|---|---|
| **Signal** | **Pin no.** | **Pin no.** | **Signal** |
| TX+ | 1 | 1 | TX+ |
| TX- | 2 | 2 | TX- |
| RX+ | 3 | 3 | RX+ |
| RX- | 6 | 6 | RX- |

| Crossover | | | |
|---|---|---|---|
| **Signal** | **Pin no.** | **Pin no.** | **Signal** |
| TX+ | 1 | 3 | RX+ |
| TX- | 2 | 6 | RX- |
| RX+ | 3 | 1 | TX+ |
| RX- | 6 | 2 | TX- |

*Table 10 Pin layout for LAN 1 Ethernet ports*

The pins 4, 5, 7 and 8 are not used.

- **LAN 2, 3 and 4 at the rear**. These LANs are of high capacity (10/100/1000 Mbps) and are of type auto crossover and auto negation. Below is the pin wiring for these LANs connected to different network capacities:

| 10/1000 or 100/1000 Mbps Ethernet | | |
|---|---|---|
| **Pin no.** | **Signal** | **Description** |
| 1 | TX_DA- | Transceive data + |
| 2 | TX_DA- | Transceive data - |
| 3 | RX_DB+ | Receive data + |
| 4 | | |
| 5 | | |
| 6 | RX_DB- | Receive data - |
| 7 | | |
| 8 | | |

| 1000/1000 Mbps Ethernet | | |
|---|---|---|
| **Pin no.** | **Signal** | **Description** |
| 1 | BI_DA+ | Bi-directional pair +A |
| 2 | BI_DA- | Bi-directional pair -A |
| 3 | BI_DB+ | Bi-directional pair +B |
| 4 | BI_DC+ | Bi-directional pair +C |
| 5 | BI_DC- | Bi-directional pair -C |
| 6 | BI_DB- | Bi-directional pair -B |
| 7 | BI_DD+ | Bi-directional pair +D |
| 8 | BI_DD- | Bi-directional pair -D |

*Table 11 Pin layout for LAN 2, 3 and 4 Ethernet ports*

To connect the Processing Unit network, use twisted pair (TP) cable with RJ-45 connectors. To comply with the IEC 60945 standard shielded (screened) cable has to be used. Recommended cable type is CAT-5e. Category 5e cable is an enhanced version of Category 5 that adheres to more stringent standards. It is capable of transmitting data at speeds of up to 1000 Mbps (1 Gigabit per second). The maximum length of the cable that can be used is 100 metres (328 ft).

### 2.12.3 MRU to Processing Unit cable wiring

The MRU is connected to the Processing Unit with a cable which is terminated in the MRU junction box in one end and with a 10 pin terminal for the Processing Unit in the other end. The MRU is then powered from the Processing Unit.

The cable wiring is as follows:

| **Processing Unit/MRU Pin no.** | **Signal** | **Pair no. Colour** | **MRU junction box Pin no.** | **MRU connector Pin no.** |
|---|---|---|---|---|
| 3 | NC | Screen | chassis (x3 side) | |
| 10 | 24V_MRU | 1 white | 1 (x1 side) | R |
| 1 | GND | 1 blue | 2 (x1 side) | B |
| 9 | RX_B | 2 white | 3 (x1 side) | C |

| Processing Unit/MRU Pin no. | Signal | Pair no. Colour | MRU junction box Pin no. | MRU connector Pin no. |
|---|---|---|---|---|
| 8 | RX_A | 2 blue | 4 (x1 side) | T |
| 7 | TX_B | 3 white | 5 (x1 side) | S |
| 6 | TX_A | 3 blue | 6 (x1 side) | P |
| 5 | XIN/MRU_1PPS_P | 4 white | 23 (x1 side) | U |
| 2 | LGND | 4 blue | 24 (x1 side) | a |

*Table 12 MRU to Processing Unit cable wiring*

The MRU is supplied with 24 V DC power from the MRU port on the Processing Unit.

Note *The shield around each pair in the cable has to be individually isolated in the 10 pin terminal. The outer shield is connected to pin 8 (screen) in this terminal, which is an open end (not connected to earth). In the MRU junction box both the shield around each pair and the outer shield are terminated in pin 1 (chassis) on the x3 side.*

Note *It is important to insert a wire between pin 24 (LGND) and pin 27 (Shutoff) on the user side (x1) in the MRU junction box in order to establish RS-422 communication between the MRU and the Processing Unit. Otherwise there will be no communication between these two components.*

## 2.13 Interfaces HMI Unit

The rear panel of the HMI Unit contains communication interface ports for interfacing to the Processing Unit. In addition, a USB and a LAN port are situated at the front together with the power switch.

| Connector | Type | Connected to |
|---|---|---|
| LAN | RJ-45 | User configurable |
| USB 1 | USB | User configurable |
| USB 2 | USB | User configurable |
| Mouse | PS/2 | Mouse |
| Keyboard | PS/2 | Keyboard |

| Connector | Type | Connected to |
|---|---|---|
| VGA | HD15 female | Monitor |
| 100 - 240 V AC | Power | Input of 100 - 240 V AC |

*Table 13 Connectors at rear of HMI Unit*

| Connector | Type | Connected to |
|---|---|---|
| USB | USB | User configurable |

*Table 14 Connectors at front of HMI Unit*

## 2.13.1 Pin layout

### 2.13.1.1 Ethernet connection

The HMI Unit has one LAN port at the rear. This port is mainly used to connect the HMI Unit to the Processing Unit (normally LAN 2) via network. This LAN has 10/100 Mbps capacity.

- To connect this LAN to a network, a straight-through twisted pair (TP) cable with RJ-45 connectors must be used. A straight-through cable is one where the pins of one connector are connected to the same pins of the other connector. Below is the pin wiring for the twisted pair (TP) cable:

| Straight-through | | | |
|---|---|---|---|
| **Signal** | **Pin no.** | **Pin no.** | **Signal** |
| TX+ | 1 | 1 | TX+ |
| TX- | 2 | 2 | TX- |
| RX+ | 3 | 3 | RX+ |
| RX- | 6 | 6 | RX- |

*Table 15 Pin layout for HMI Unit Ethernet ports*

The pins 4, 5, 7 and 8 are not used.

To connect the HMI Unit network, use twisted pair (TP) cable with RJ-45 connectors. To comply with the IEC 60945 standard, shielded (screened) cable has to be used. Recommended cable type is CAT-5e. Category 5e cable is an enhanced version of Category 5 that adheres to more stringent standards. It is capable of transmitting data at speeds of up to 1000 Mbps (1 Gigabit per second). The maximum length of the cable that can be used is 100 metres (328 ft).

# 3 INSTALLATION

This chapter covers installation of the Seapath 320 system. The installation includes:

- Location of the system parts (Processing Unit, HMI Unit, MRU, GNSS antennas)
- Mounting of the Seapath cabinet
- Mounting of the MRU bracket
- Installation of the coax connectors
- Mounting of the antenna bracket, GNSS antennas and cable
- Connection of cables between Seapath and external equipment
- System start

## 3.1 Logistics

**Safety**: General safety guidelines to be followed when working in mast and on deck.

**Personnel qualifications**: Trained electrical workers.

**Minimum number of personnel**: 2, especially when mounting the Antenna Bracket to the Holder.

**Ship location**: The GNSS antennas have to be mounted such that blocking of the GNSS signal is avoided. The MRU 5 unit is preferably mounted low in the ship or close to the system to be compensated. The Processing Unit can be mounted on the bridge or in the instrument room. The HMI Unit, the monitor is typically mounted on the bridge.

**Special tools required**: None.

## 3.2 Location of the system parts

The following sections contain instructions regarding mounting of the various system parts.

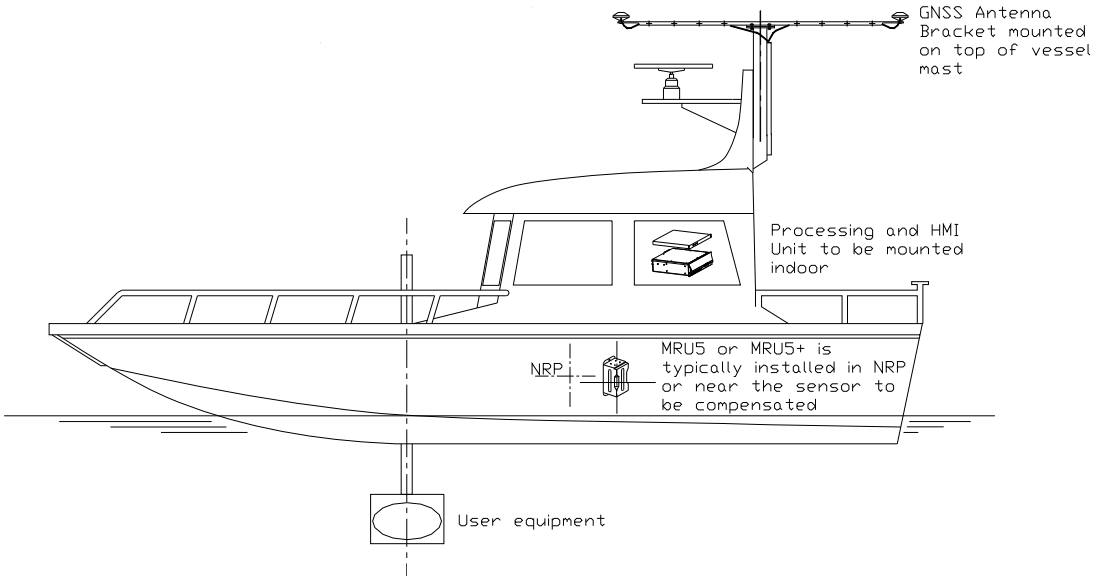



*Figure 14 Location of system parts*

### 3.2.1 GNSS antennas

For the GNSS antennas, consider the following:

- The space above the antennas has to be free of obstructions of any kind. The antenna should be protected from direct illumination of radar beams and other transmitting antennas such as Inmarsat antennas. Seapath is more sensitive to blocking and reflections (multipath) of GNSS signals than GNSS sensors which only utilise pseudo-range data. This since Seapath also utilises carrier phase measurements for heading determination, and both GNSS antennas need to see at least four common satellites at the same time.

*Caution* *The GNSS antennas have to be mounted in such a way that blocking of the GNSS signal I avoided.*

- In order to reduce problems due to multipath effects, the GNSS antennas have to be mounted above the nearest deck at a height which is equal to the width of this deck or higher.
- The Antenna Bracket has to be mounted in such a way that torsion movement relative to the ship's hull is kept at an absolute minimum.

*Note* *If the Antenna Bracket supplied by Kongsberg Seatex is not used, it is important that the antennas are rigidly mounted so that the distance between the antennas does not change due to vibrations or accidental dislocation.*

- The antenna baseline length is recommended in the range 2.5 to 4.0 metres, but 1 to 5 metres can be used. Maximum heading accuracy is achieved at 4.0 metres baseline.
- The maximum length for each of the antenna coaxial cables is 100 metres for the cable type normally delivered with the system (1/2" Superflex). If longer cables are needed, a low noise signal amplifier (LNA) should be fitted.

### 3.2.2 MRU 5

For the MRU, consider the following:

- The unit is designed for installation in an indoor environment and for operation within the temperature range.
- The unit is to be mounted close to the user equipment of which it is supposed to measure the motion. This is to avoid errors in alignment with the user equipment and to eliminate errors due to ship hull torsion.
- If the system is not allocated to measure motion of a particular user equipment, mount the MRU as close to the Navigation Reference Point (NRP) as possible. This to ensure best roll and pitch measurements. If it is not possible to mount the MRU close to NRP, try to mount it along the longitudinal axis of the ship and as close to the NRP as possible. Avoid mounting the MRU high up or out to the side of the ship.

Be aware of:

**Vibrations** Direct mounting onto the main hull structure is preferable.

*Note* *The worst mounting positions are thin walls that may come in resonance with vibrations driven by machinery, propellers, pumps or motors. Avoid mounting the MRU close to hydraulic pumps and valves where there are high frequency vibrations.*

**Temperature changes** For safe mounting of the MRU, place the unit in a location where the temperature is low and where changes in temperature are slow. A location directly on the hull far away from the heat of the machinery, heaters and air conditioning systems is preferable.

**Corrosion problems** Place the MRU in a location where no direct splashing seawater is present.

### 3.2.3 Processing Unit

When installing the Processing Unit, consider the following:

- The unit is designed for indoor installation and should not be exposed to heavy vibrations, transformers or similar.
- The unit should be resiliently mounted in a 19-inch rack to be in accordance with the environmental standard IEC60945/EN60945.
- The unit has an internal fan and requires free airflow from the rear and out to the sides. It is recommended that ventilation or air conditioning is provided in order to keep the ambient operating temperature around +20 °C. The best location is typically in the instrument room or on the bridge mounted into a 19-inch rack with good ventilation and resilient mounting.
- It is recommended that the area around the unit is kept free from dust and static electricity.
- All connections to the unit are on the rear side and available space for cable connections and service must be provided.

### 3.2.4 HMI Unit

When installing the HMI Unit, consider the following:

- The unit is designed for indoor installation and should not be exposed to heavy vibrations, transformers or similar.
- The unit should be resiliently mounted in a 19-inch rack to be in accordance with the environmental standard IEC60945/EN60945.
- The unit has an internal fan and requires free airflow from the rear and out to the sides. It is recommended that ventilation or air conditioning is provided in order to keep the ambient operating temperature around +20 °C. The best location is typically on the bridge mounted into a 19-inch rack with good ventilation and resilient mounting.
- It is recommended that the area around the unit is kept free from dust and static electricity.
- All connections to the unit are on the rear side and available space for cable connections and service must be provided.

### 3.2.5 Monitor

When installing the monitor, consider the following:

- The unit is designed for installation in an indoor environment and for operation within the temperature range. The best location is typically on a table in the instrument room or on the bridge mounted close to the HMI Unit.

- The HMI Unit and the monitor should be mounted close to each other to reduce the length of the VGA cable.
- It is recommended that the area around the unit is kept free from dust and static electricity.

## 3.3 Survey of sensors on vessels

All sensors need to be surveyed. The points to measure on the various sensors (MRU, GNSS antenna, gyro), and the accuracy requirements, depend on the function of the sensor.

If a sensor has a defined direction (fwd/stb/up), the direction in which it is mounted must be determined.

All available sensors can be surveyed either in dock or alongside.

### 3.3.1 Vessel reference system

All vessels must have a defined Cartesian coordinate system to which all sensors must be referenced. This system should be well described in both text and drawings to avoid common misunderstandings.

Such a coordinate system can consist of a Y-axis (positive forwards) which is parallel to the centre line of the vessel, an X-axis (positive to starboard) and a Z-axis (positive upwards). All axes are mutually perpendicular.

The origin, where Y=0, X=0 and Z=0 (CRP, or Common Reference Point), is normally defined to be at the AP (centre Rudder Stock, underside keel), which is also where the design origin is commonly located in GA drawings.

The reference plane of this system must be well defined and described. This can be a Best Fit Plane top main deck or a Best Fit Plane through the draught marks on the hull. This is particularly important on a floating vessel, as it is not possible to project the horizontal plane from land.

*Note* *If the CRP is to be located at the Centre of Gravity (COG), the load conditions used when defining the COG must be known, as the actual COG moves dynamically depending on load conditions of the vessel.*

### 3.3.2 MRU

The following is to be surveyed:

- Position (X,Y,Z) of sensor point (e.g. for an MRU 5 use centre top chassis)
- Mounting angles:

- Yaw (heading)
- Pitch
- Roll

Pitch and Roll mounting angles should ideally be confirmed against MRU logs, for instance during Gyro calibration.

### 3.3.3 GNSS antennas

The following is to be surveyed:

- Position (X,Y,Z), centre of the antenna disc (or otherwise defined sensor point).
- Angular offset between the line from centre antenna #1 to centre antenna #2 and the vessel centre line (CL).

*Note* *This offset should be confirmed against a Seapath GPS heading log, typically during gyro calibration.*

### 3.3.4 Gyro

If a gyro compass is interfaces to the Seapath system, the following is to be surveyed:

- The offset between the gyro compass heading and the vessel centre line (CL).

*Note* *The heading offset to be surveyed to an accuracy better than 1°.*

Static gyro calibration/verification (heading log) and DGNSS health check should be done after all DGNSS and gyro systems are installed and fully operational. This can be performed in dock or alongside.

Dynamic gyro calibration/verification and attitude control (heading, roll, pitch control) must be performed at sea.

### 3.3.5 Survey accuracy

The Seapath 320 product must be surveyed to the following accuracy level. If not, the performance of the product will be degraded.

- Lever arm vector from CRP to GNSS antenna position (X, Y, Z): < 0.1 metre.
- Lever arm vector from CRP to MRU (X, Y, Z): < 0.1 metre.
- MRU 5 misalignment angles (Roll, Pitch, Yaw) with the vessel axes: < 0.1°.

## 3.3.6 Cabinet mounting

### 3.3.6.1 Mounting Seapath with delivered cabinet

The cabinet should be securely mounted. Drilling plan for the resilient mountings is included in the attached drawings.

*Caution* *The cabinet must be connected to a grounded outlet.*

It is recommended that the cables attached to the rear of the unit should be long enough to accommodate all service from the front.

The cabinet must be mounted in such a way that the minimum cable bends (on the rear side) are not exceeded. For the antenna cables it may be necessary to use the short transition RG-213 or RG-214 cable in order to route the cables properly into the cabinet.

### 3.3.6.2 Mounting Seapath without delivered cabinet

A system delivered without a cabinet shall be mounted on attachment rails in a standard 19-inch rack. Minimum depth of the rack is 500 mm. It is recommended that the rack is resiliently mounted.

It is recommended that the rack has air inlet on top and bottom or ventilation splits on the sides. The Processing and HMI units have ventilation on the sides. Forced ventilation may be required if the cabinet contains several electronic modules.

All cables connected to the unit must be screened. Make sure that the minimum antenna cable bends are not exceeded.

*Note* *The recommended keyboard cable length is 3.3 m (10 feet) maximum without degradation. If longer keyboard cable is needed, please use keyboard extender.*

# 4 CONFIGURATION

Seapath has a graphical user interface which includes configuration, data presentation and sensor status. This chapter describes the Seapath configuration management system.

## 4.1 Starting the system

After installing the equipment according to the procedures, the system can be started. Press the power switch on the front of the Processing and HMI Units to start the systems.

The system will start automatically after power on. Normally, the unit will output signals on the serial lines without any involvement from the user.

## 4.2 System configuration

### 4.2.1 System modes

The product has three system modes, indicated in the System mode field of the **Top bar**:

**Operation mode** This is the default mode. In this mode it is not possible to launch any external applications, diagnostic tools or reconfigure the system.

**Configuration mode** In this mode it is possible to change settings related to the connected sensors, applications and system-wide settings.

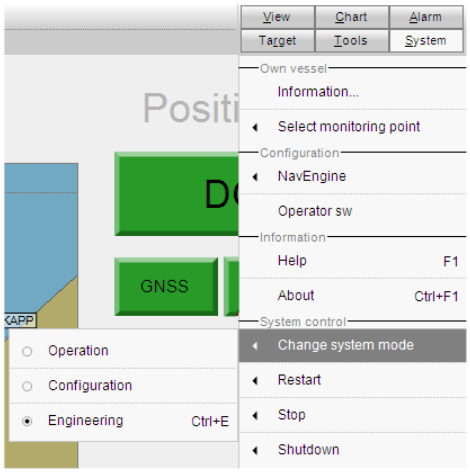



*Figure 15 Change system mode menu*

**Engineering mode** This mode is primarily intended for field engineers during initial installation, fault diagnostics and system-wide reconfiguration.

A password is required to switch from Operation to Engineering or Configuration mode. The password is "stx", and it is not possible to change. The system will return to Operation mode after 3 minutes of user inactivity.

## 4.3 NavEngine configuration

From the **System** menu, configuration of NavEngine is available. Two modes of configuration are available, **Standard** and **Advanced**. The Standard configuration is available when logged into Configuration mode, while the Advanced configuration is available in Engineering mode.

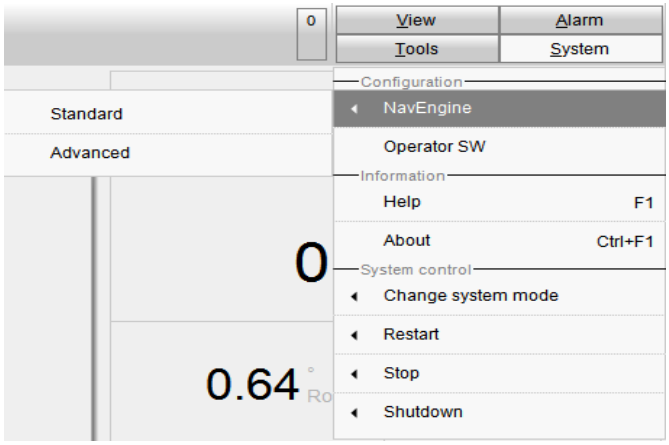



*Figure 16 NavEngine configuration*

## 4.4 Standard configuration

When **Standard** configuration is selected from the **System** menu, the **NavEngine Configuration** view is displayed.

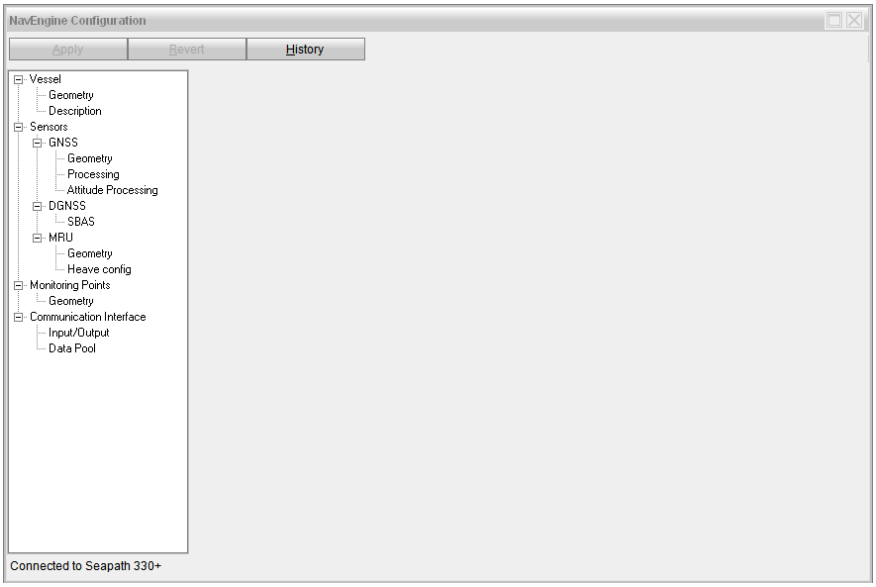



*Figure 17 NavEngine Configuration view*

At the top of the **NavEngine Configuration** view there are three buttons to handle the configuration parameters.

**Apply** To save the parameter settings, the **Apply** button must be pressed.

**Revert** The **Revert** button contains the last applied configuration parameters.

**History** A new configuration file is stored each time the **Apply** button is pressed. From the **History** button, the saved files are available. The files are named with the date and time they were saved. The ten last files are displayed in the list. Via the **Browse…**button at the bottom of the list it is possible to find all saved files.

*Figure 18 History button*

The following parameters can be set in the Standard configuration:

- Vessel geometry and description
- Sensor data, including:
  - GNSS geometry and processing
  - DGNSS and SBAS
  - MRU geometry and heave config
- Monitoring points geometry
- Communication interface, including:
  - Input/Output
  - Data pool

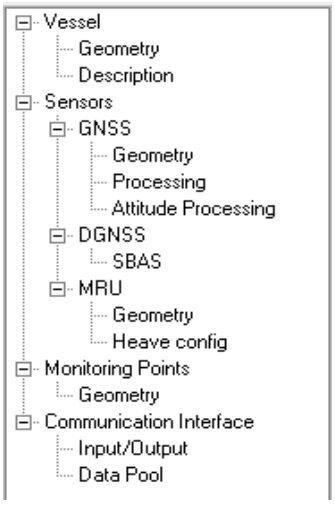



*Figure 19 Configuration manager*

### 4.4.1 Vessel configuration

In the Vessel configuration the following can be input:

**Geometry** For later configuration of sensor and monitoring point locations on the vessel it is an advantage that the background vessel (vessel shape) is as equal as possible to the vessel on which the system is installed. The background vessel is scaled on the screen to be equal to the installed vessel. To scale the vessel shape on the screen to the actual vessel, its dimensions have to be input.

**Description** Vessel data for the specific installation. This information is helpful to identify the correct configuration file at a later stage.

#### 4.4.1.1 Vessel geometry

The Vessel Geometry view defines the vessel dimensions.

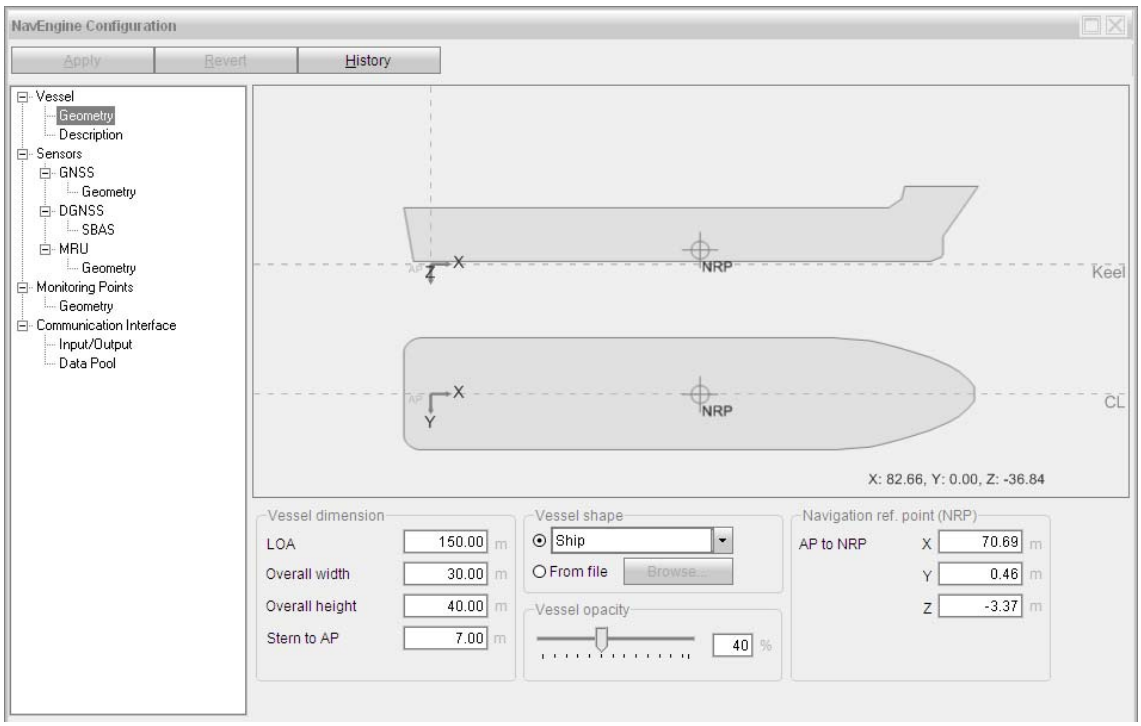



*Figure 20 Vessel geometry view*

In the **Vessel dimension** section it is possible to set the following parameters:

**LOA** The overall length of the vessel, i.e. from stern to bow [m].

**Overall width** The overall width of the vessel [m].

**Overall height** The distance from the highest point of the vessel to the keel [m].

**Stern to AP** The distance from the aft point of the ship to its AP [m].

In the **Vessel shape** section it is possible to select the vessel shape or to get the vessel shape from a file.

**Vessel shape** The vessel shapes supported are ship, rig and jackup.

**From file** Input of vessel shape from file, see separate section.

**Vessel opacity** A percentage scaling of the opacity of the vessel shape on the screen.

In the **Navigation ref. point (NRP)** section, the distance between AP and NRP is defined.

**AP to NRP** The distance from AP to NRP [m]. The Navigation Reference Point location (NRP) is the reference point for all measurements in the system. The recommended used NRP is the vessel CG or rotation centre.

#### 4.4.1.2 Vessel description

The Vessel Description view contains mostly textual information regarding the vessel.

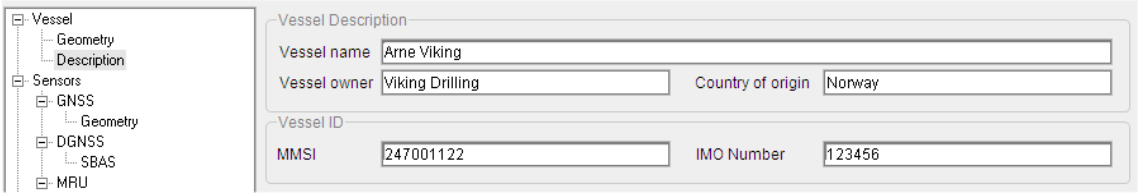



*Figure 21 Vessel Description view*

**Vessel name** The name of the vessel.

**Vessel owner** The name of the vessel owner.

**Country of origin** The name of the vessel's country of origin.

**MMSI** The MMSI assigned to the vessel.

**IMO Number** The IMO ID assigned to the vessel.

### 4.4.2 GNSS configuration

#### 4.4.2.1 GNSS Geometry

The lever arm vector from the AP to GNSS antenna no. 1 has to be measured or calculated based upon drawings or previously measured points, and entered into the software. The antenna cable connected to GNSS1 at the back of the Processing Unit will be GNSS antenna no. 1 in the installation. Proceed as follows:

- **Antenna location**. Set the **Antenna location** coordinates for the GNSS antenna which is defined to be antenna no. 1, normally the antenna closest to the aft of the vessel. Check that the antenna has been located on the expected spot in the vessel

shape. If not, check the signs and the co-ordinates input for GNSS antenna no. 1, the vessel dimension and the entered location of AP.

- **Antenna configuration**. In the **Antenna configuration** section, input the antenna type (Novatel NOV600, NOV702 or NOV702GG or GENERIC. NONE means no antenna dome or choke ring included), baseline length 2.5 metres if the standard Antenna Bracket is used, otherwise this length has to be measured manually and this value entered. For the heading offset and height difference input zero. Then click on the **Calibration wizard** button to prepare the calibration. The Heading Offset and Height Difference is automatically updated trough the Calibration wizard process. Check that the orientation of the antennas in the vessel shape correspond with the actual orientation in the mast. See the chapter Calibration for description on how to use the Calibration wizard.

Note *Correct selection of antenna type is only important when raw GNSS data are output from the Seapath for post-processing of the position accuracy. The selection GENERIC as antenna type is used for all single-frequency antennas (L1) and for Seapath installations that shall not use RTCM output for post-processing. If other antennas than those listed are used, check the following link to find the correct antenna type; ftp://igscb.jpl.nasa.gov/igscb/station/general/rcvr_ant.tab. Other antenna types than those listed are input in the Seapath configuration by using the **Advanced** option in **NavEngine configuration** on the System menu.*

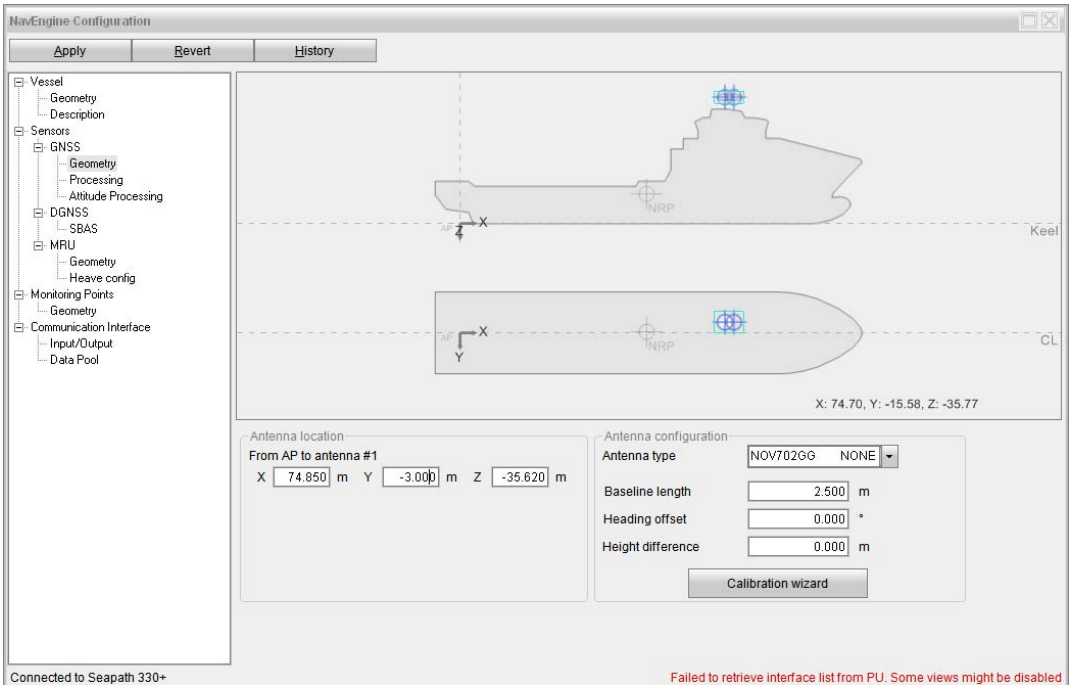



*Figure 22 GNSS sensor geometry configuration view*

#### 4.4.2.2 GNSS Processing

For operations with weak satellite geometry the position output can be made more accurate by using height aiding and low elevation mask. For normal operations the Height Aiding mode is set to Off but Filter is also recommended used. The elevation mask is set to 10 degrees as the default value and must not be changed by other than experts. For the Seapath 310 and 330 models the search mode for the RTK solution has three selections: Safe, Normal and Fast. The default RTK search mode is Normal. In order to change the default GNSS Processing settings, proceed as follows:

- Set the Seapath in Height Aiding mode by pulling down the Aid Mode drop-down list and change the selection from Off, which is the default setting, to Filter. The Aided Height is for the NRP and measured above the ellipsoid. This height should be set when Filter is selected since the filter will start with the entered height value as the initial value.
- The SV masking value can be changed from the default value 10 by entering an Elevation mask value between 7 and 20 degrees. This value must not be changed by other than experts from the default value 10.
- Click the checkbox **Enable range rate corrections** to use the DGNSS corrections in the GNSS velocity calculations. The default setting is enabled on use of range rate corrections. Disabling range rate corrections will reduce velocity and attitude noise when receiving DGNSS corrections from a reference station with a noisy range rate.
- For the Seapath 310 and 330 models the search mode for the RTK solution should be changed from the default mode Normal to Safe or Fast by pulling down the **RTK search mode** drop-down list. The Safe mode is recommended used under difficult conditions with much multipath or ionospheric activity and for long baselines. The Fast mode is used when a fast RTK solution is required. However, in this mode the probability for an incorrect solution from the system increases.

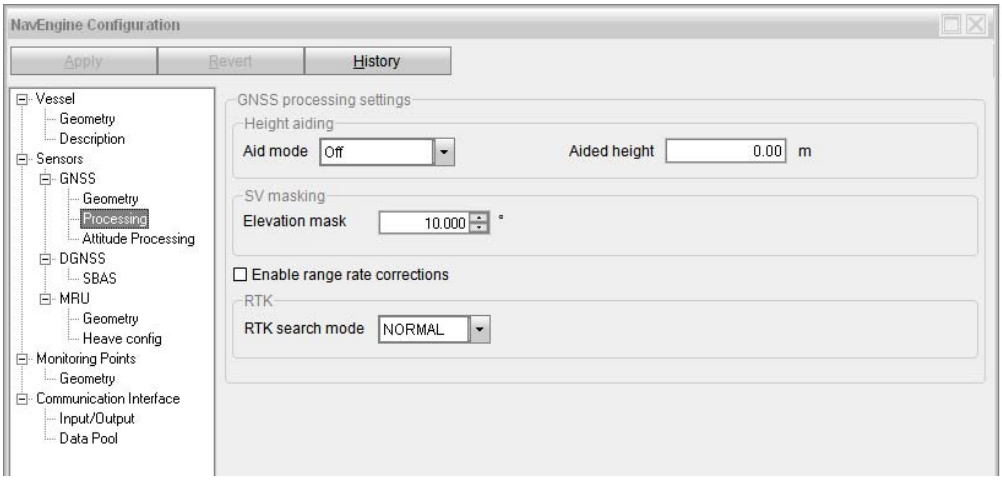



*Figure 23 GNSS Processing settings view*

→ *For more information on how to select the best values for GNSS Processing, see Operating Instructions in the User Manual.*

#### 4.4.2.3 GNSS Attitude Processing

In this dialogue the maximum values to be used for attitude processing can be changed. However, these parameters are only to be changed if the vessel has an unusual characteristic.

*Figure 24 GNSS Attitude Processing view*

## 4.4.3 DGNSS configuration

### 4.4.3.1 SBAS tracking

In the SBAS tracking view it is possible to set up Automatic or Manual tracking of SBAS satellites. When Automatic tracking is selected, the GNSS receiver chooses which SBAS satellites to track.

In Manual mode the user must set up which SBAS satellites to use. If two SBAS satellites are selected, the system will automatically select and use data from the best satellite. If only one SBAS satellite is selected, only correction data from this satellite will be used in the computations.

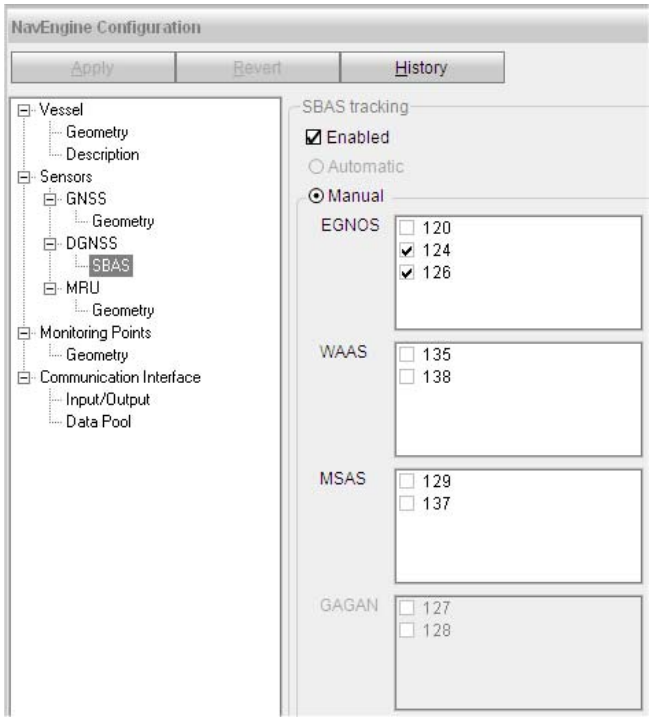



*Figure 25 SBAS tracking view*

If no specific SBAS satellite is selected, the system will select and use data from the best of the available satellites.

If the selected SBAS satellite is not available, the system will not use the SBAS correction data in the computations.

Maximum two SBAS satellites may be tracked by the GNSS receiver.

## 4.4.4 MRU configuration

### 4.4.4.1 MRU Geometry

The lever arm vector from the AP to the MRU location has to be measured or calculated based upon drawings or previously measured points, and entered into the software. Look at the sketch of the MRU geometry on the screen in order to enter correct signs on the co-ordinates. Check also that the MRU has been located on the expected spot in the vessel shape. If not, check the signs and the co-ordinates input for the MRU, the vessel dimension and the entered location of AP.

The MRU mounting angles can either be input manually or determined by use of the **Mounting Wizard**. To use the MRU Mounting Wizard, see separate section in this manual.

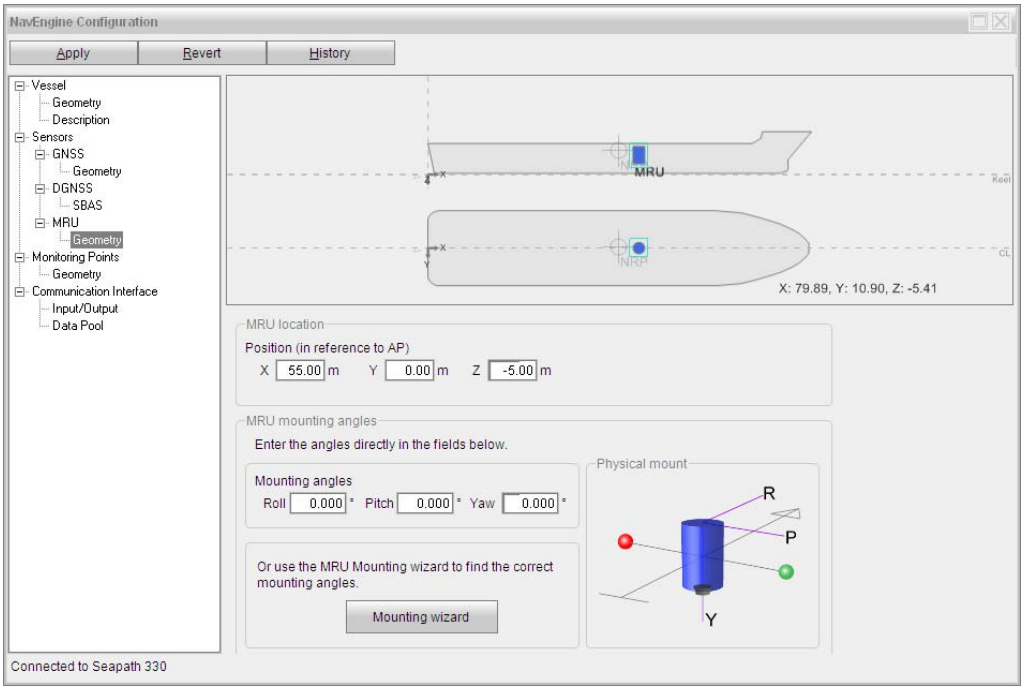



*Figure 26 MRU geometry view*

**MRU location** Enter the position of the MRU in X, Y, Z coordinated from AP. The MRU location has to be measured or calculated based upon drawings or previously measured points.

**MRU mounting angles** The mounting angles of the MRU in roll, pitch and yaw have to be input to the MRU. The MRU mounting wizard can be used to determine these mounting angles.

#### 4.4.4.2 Heave configuration

When using real-time heave measurements, it is important to tune the heave parameters (heave period and damping) to the vessel size and the motion characteristics for the actual weather conditions. The default settings for filter mode heave period and damping, have to be tuned for the actual vessel and weather conditions in order to achieve optimum heave performance. Therefore, before a survey and/or during operation check the heave performance of the Seapath and tune the heave parameters until the best heave performance is achieved. An alternative is to select Automatic and let Seapath automatically choose the best settings. The following should be considered when selecting the different heave filter modes and parameters:

Filter mode:

- **Automatic**. To be selected when the vessel is operating in various sea states or when the average heave period is unknown.
- **General purpose**. Is selected when an optimal heave amplitude is to be measured and the heave phase is of no importance. This mode is typically selected when the Seapath is to be used for measuring the heave height and period on oceanographic buoys.
- **Hydrographic survey**. To be selected when the heave phase and amplitude have to be output correct in real time. This mode is typically selected when the heave output signal from the Seapath is to be used for heave compensation of echo sounders and offshore crane systems.

Period:

- An expected average heave period has to be set to the heave filter. This period can be determined by measuring the time between two wave-tops by using a watch.
- The settling time for the heave measurements from power-on or after a turn will be about 10 times the selected period, $T_o$. By selecting an unnecessary long heave period, the settling time will be slower than it has to. For vessels performing surveys with frequent turns, the period should be set as low as possible to minimise the heave settling time after turns.

Damping:

- The heave damping factor is usually set to 0.7. Only for special occasions should this parameter be changed. In operations with heave periods of more than 25 seconds, the damping factor should be reduced to 0.6 in order to achieve correct phase measurements. In operations with heave periods of less than 2 seconds, the damping factor should be increased to 0.8.

→ *For more details on selection of heave filter mode and parameters, see the User Manual.*

In order to select the heave configuration proceed as follows:

- Enter the settings for heave filter in the **MRU Heave config** dialogue. The pull-down Option menu has the following options; Integrated, Automatic, Hydrographic survey or General purpose. In Integrated, Hydrographic survey and General purpose mode, the filter parameter for Period can be set to a value between 1 and 25 seconds, and the Damping value between 0.2 and 1.

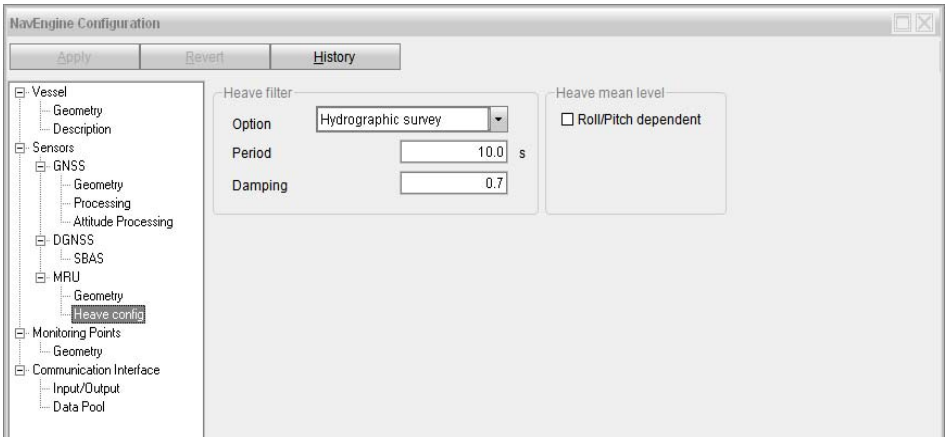



*Figure 27 Heave filter view*

- Click on the checkbox **Roll/Pitch dependent** in the Heave mean level section to make the heave measurement dependent on the roll and pitch measurements. Then the heave position in the monitoring points (MP) now longer has zero mean level, instead its value depends on the vessel tilt at any time. This option is useful especially in applications where the distance between the MP and the sea level is to be determined, like in echo sounder installations with depth changes due to changes in vessel trim and list. If this mode is not selected, the heave will always have zero mean level.

### 4.4.5 Monitoring points

Enter the **Monitoring Point** configuration dialogue to configure monitoring points for output of data. Up to 8 monitoring points may be defined. As the monitoring points are inserted, they are displayed graphically. The monitoring points are given relative to the AP.

Check that the monitoring points have been located on the expected points in the vessel shape. If not, check the signs and the co-ordinates input for each monitoring point, the vessel dimensions and the entered location of AP.

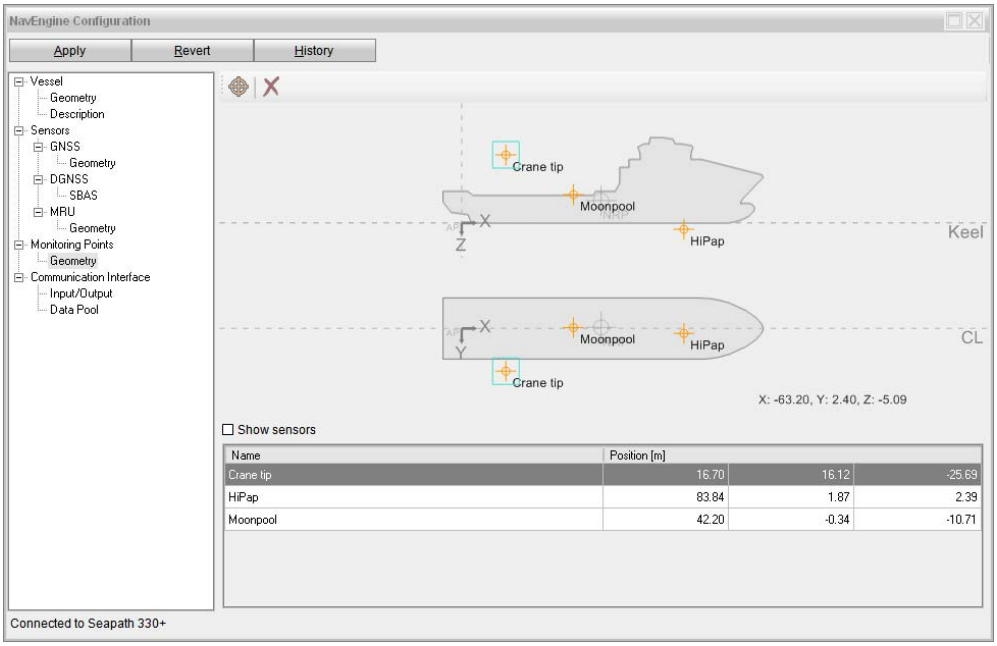



*Figure 28 Monitoring points view*

To add a monitoring point, select the **Add** icon in the upper left corner of the view and drag the symbol to the correct location on the vessel. The selected monitoring point coordinates are shown at the bottom of the view.

To get exact coordinates from AP to each monitoring point, each monitoring point has to be measured or calculated based upon drawings or previously measured points, and entered into the software manually. To delete a point, select the cross.

Note *If data shall be valid for NRP, it is not necessary to define a zero vector since the data is default output in NRP.*

When the **Add** icon is selected, red lines will be displayed on the screen to help placing the new point. Co-ordinates will also be displayed to help placing the monitoring point. The position and name of the added point may also be adjusted by writing the co-ordinates into the table below the vessel drawing.

Figure 29 illustrates adding a new monitoring point by clicking on the cross symbol and dragging the mouse and cross to the correct location.

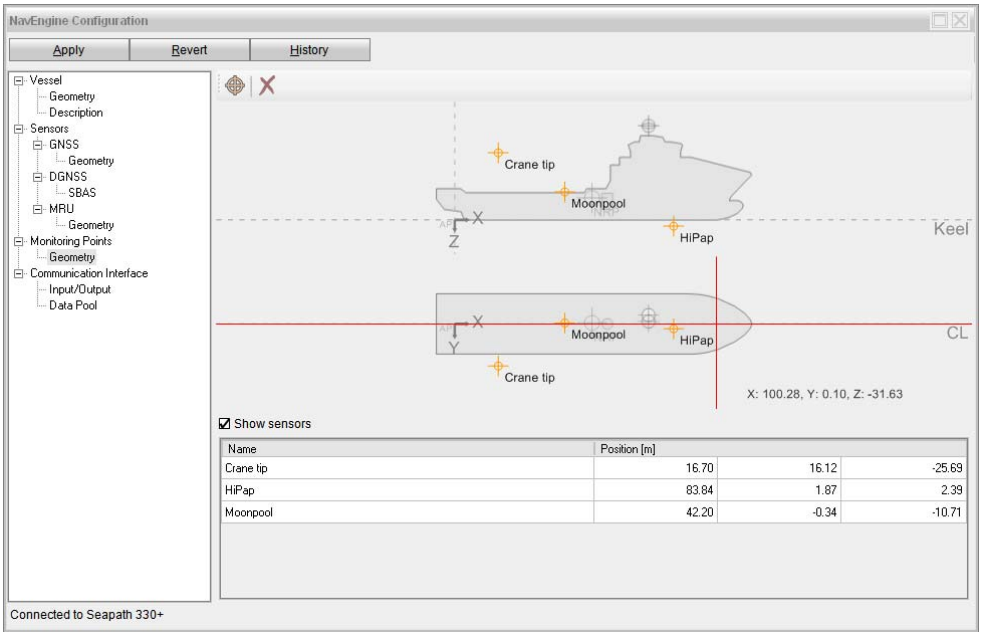



*Figure 29 Add a new monitoring point*

Figure 30 illustrates that a new monitoring point, MP4, has been added to the list of monitoring points.

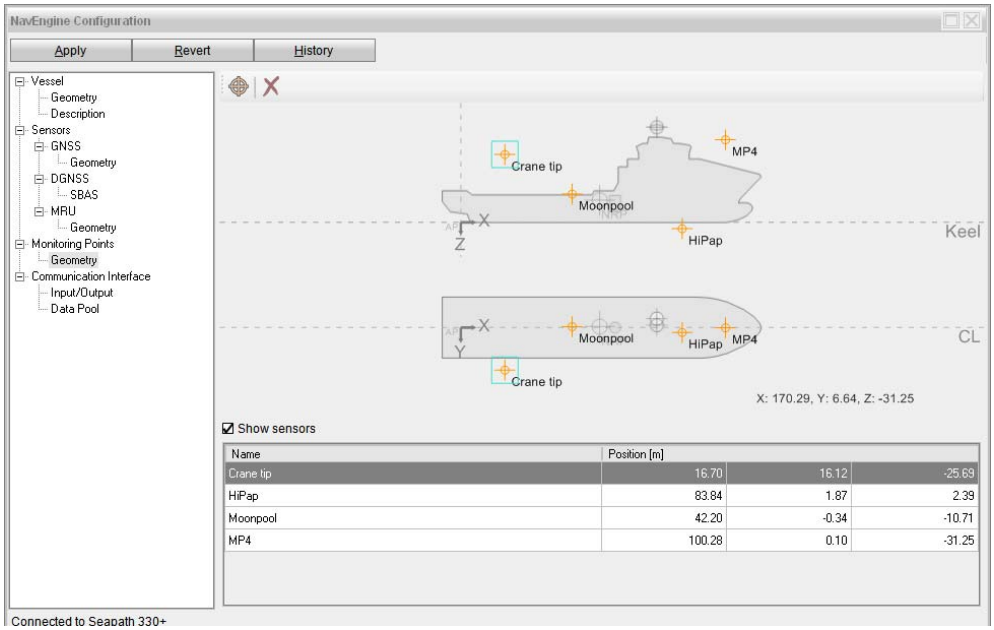



*Figure 30 New monitoring point, MP4, added to list*

Figure 31 illustrates renaming of a monitoring point to a preferred name, here from MP4 to Helideck.

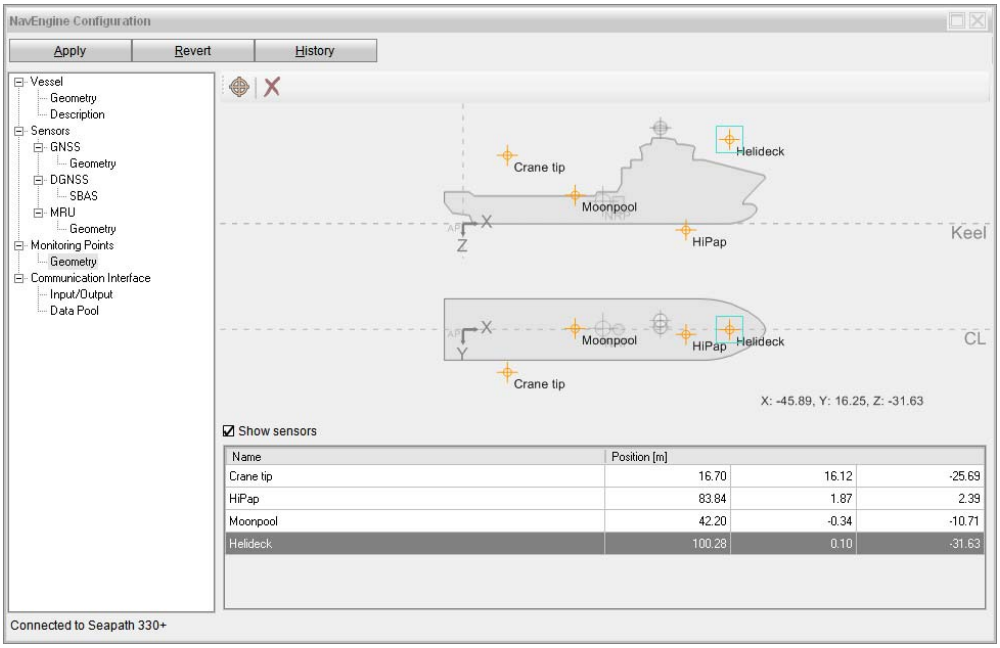



*Figure 31 Renaming of monitoring point to preferred name*

## 4.4.6 Communication interface

### 4.4.6.1 Input/Output

The figure below displays a default view for the Input/Output communication before any interface details are added.

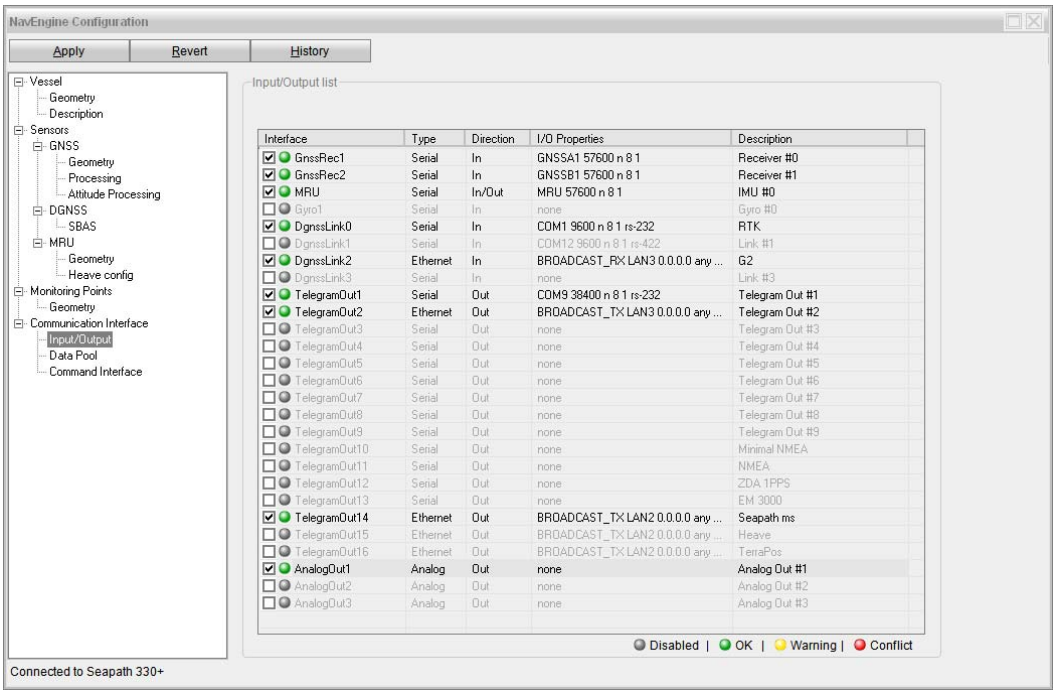

NavEngine Configuration
Apply
Revert
History
Vessel
Geometry
Description
Sensors
GNSS
Geometry
Processing
Attitude Processing
DGNSS
SBAS
MRU
Geometry
Heave config
Monitoring Points
Geometry
Communication Interface
Input/Output
Data Pool
Command Interface
Input/Output list
Interface
Type
Direction
I/O Properties
Description
GnssRec1 Serial In GNSSA1 57600 n 8 1 Receiver #0
GnssRec2 Serial In GNSSB1 57600 n 8 1 Receiver #1
MRU Serial In/Out MRU 57600 n 8 1 IMU #0
Gyro1 Serial In none Gyro #0
DgnssLink0 Serial In COM1 9600 n 8 1 rs-232 RTK
DgnssLink1 Serial In COM12 9600 n 8 1 rs-422 Link #1
DgnssLink2 Ethernet In BROADCAST_RX LAN3 0.0.0.0 any ... G2
DgnssLink3 Serial In none Link #3
TelegramOut1 Serial Out COM9 38400 n 8 1 rs-232 Telegram Out #1
TelegramOut2 Ethernet Out BROADCAST_TX LAN3 0.0.0.0 any ... Telegram Out #2
TelegramOut3 Serial Out none Telegram Out #3
TelegramOut4 Serial Out none Telegram Out #4
TelegramOut5 Serial Out none Telegram Out #5
TelegramOut6 Serial Out none Telegram Out #6
TelegramOut7 Serial Out none Telegram Out #7
TelegramOut8 Serial Out none Telegram Out #8
TelegramOut9 Serial Out none Telegram Out #9
TelegramOut10 Serial Out none Minimal NMEA
TelegramOut11 Serial Out none NMEA
TelegramOut12 Serial Out none ZDA 1PPS
TelegramOut13 Serial Out none EM 3000
TelegramOut14 Ethernet Out BROADCAST_TX LAN2 0.0.0.0 any ... Seapath ms
TelegramOut15 Ethernet Out BROADCAST_TX LAN2 0.0.0.0 any ... Heave
TelegramOut16 Ethernet Out BROADCAST_TX LAN2 0.0.0.0 any ... TerraPos
AnalogOut1 Analog Out none Analog Out #1
AnalogOut2 Analog Out none Analog Out #2
AnalogOut3 Analog Out none Analog Out #3
Disabled | OK | Warning | Conflict
Connected to Seapath 330+

*Figure 32 Input/output view before interface details are added*

When selecting an interface, the Input/Output view will be divided into two sections. The upper part consists of the list with all interfaces.

The lower part consists of **Configuration details** for the interface selected in the list. The configuration details vary between the different interfaces.

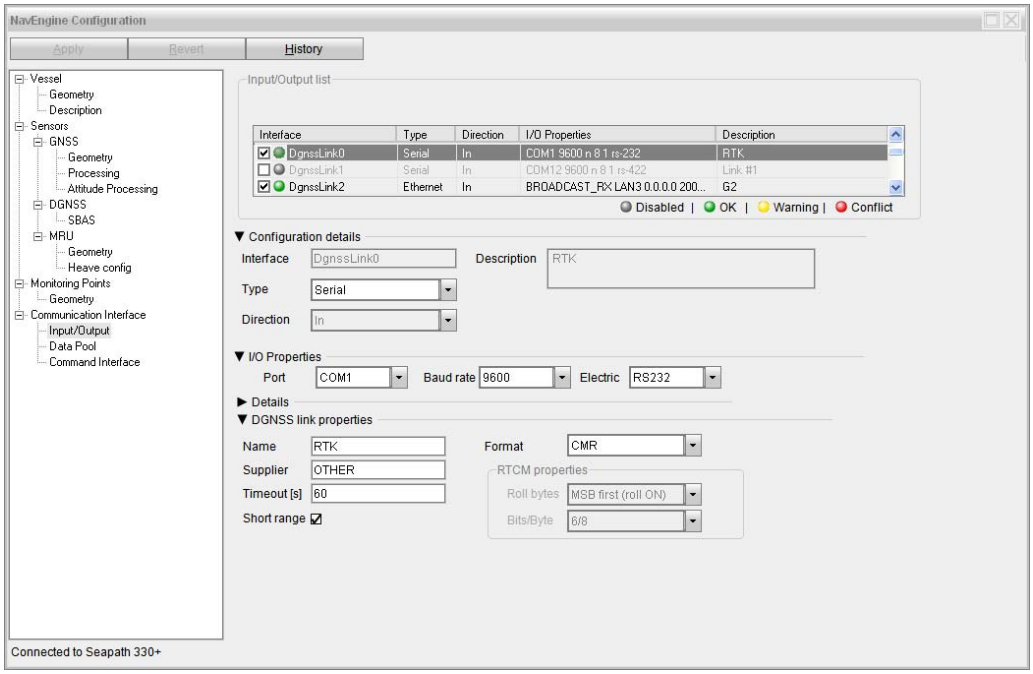



*Figure 33 Input/Output list view with configuration details*

### 4.4.7 Data pool

Data pool is the distribution media for data from the NavEngine software to the operator software.

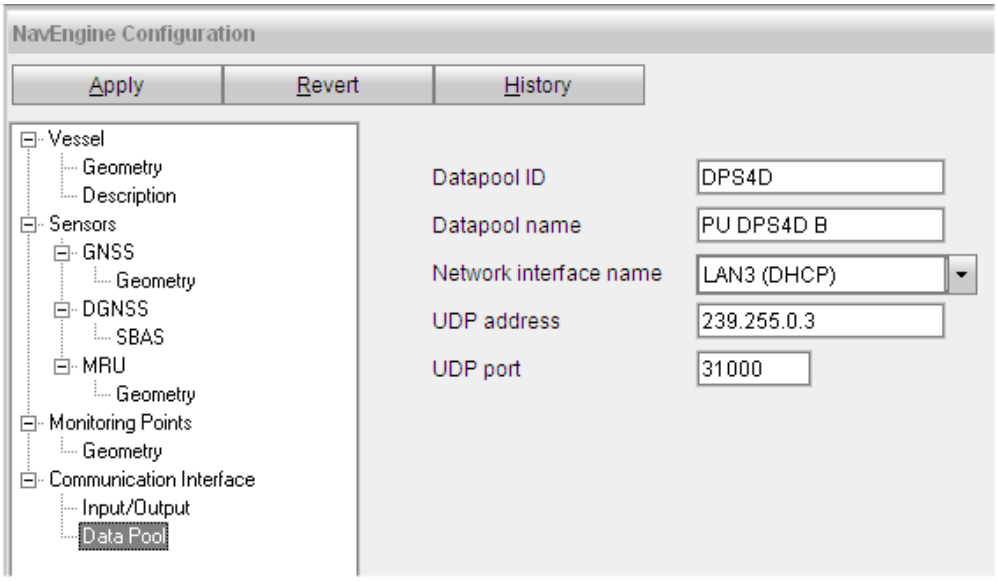



*Figure 34 Data Pool configuration view*

**Datapool ID** Identification ID. Own text may be inserted.

**Datapool name** Identification name. Own text may be inserted

**Network interface name** The LAN port on the Processing Unit.

**UDP address** The address the NavEngine should send data to.

**UDP port** The port the NavEngine should send data to**.**

Note *If the NavEngine should send data to the Operator software, the UDP address and UDP port must match the Address and Port entered in the Data Source tab in the Operator software configuration.*

# 5 OPERATING INSTRUCTIONS

The Seapath will start automatically after power on and it is operated through the operator software installed on one or more HMI Units. The software is used for performance monitoring, configuration and system troubleshooting.

Normally, the system outputs signals on the serial lines, analog channels and Ethernet ports without any involvement from the user. After power on, up to 30 minutes is needed to obtain full accuracy on all data. Since there normally is no reason to turn off Seapath, it should be left running continuously.

In the following chapters, the various display pages comprising the Seapath will be described for better understanding of the displayed parameters.

## 5.1 Screen sections views

The main application window of the system is divided into four sections: **Top bar**, **View 1**, **View 2** and **View 3**. The size and position of the sections are fixed.

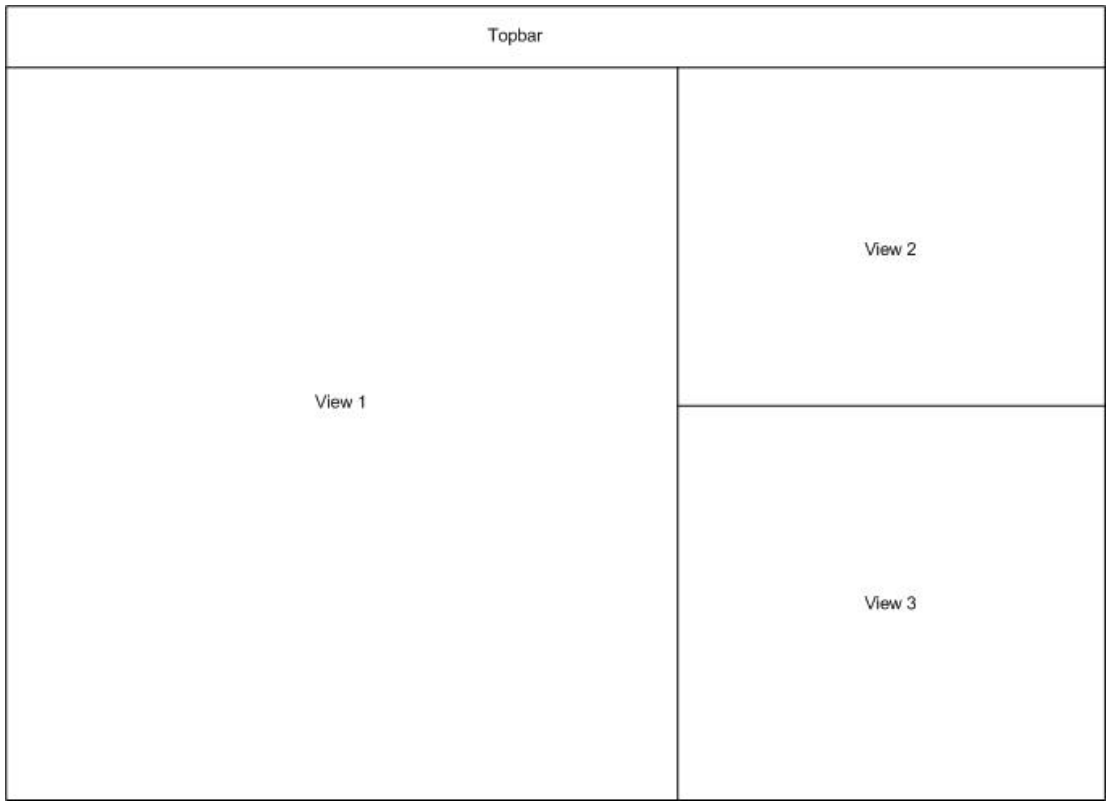



*Figure 35 Main view sections*

### 5.1.1 Switch and select views

The operator may select between the following views:

- Combined view
- Sky view
- DGNSS age view
- DGNSS status view
- Position integrity
- Compass
- Motion data
- Time Series view

Press **F2** to browse to the next available view in View 2.

Press **Shift+F2** to browse to the next available view in View 3.

Press **F3** to switch the contents of View 1 and View 2.

Press **Shift+F3** to switch the contents of View 1 and View 3.

Press **F5** to let View 1 cover the whole screen.

## 5.2 Top bar

The **Top bar** includes the following information:

- Type of system
- Current date and time (UTC)
- Data source
- System mode
- Data quality status
- System status
- Event message list including type of event and time tag for the event
- Application menu

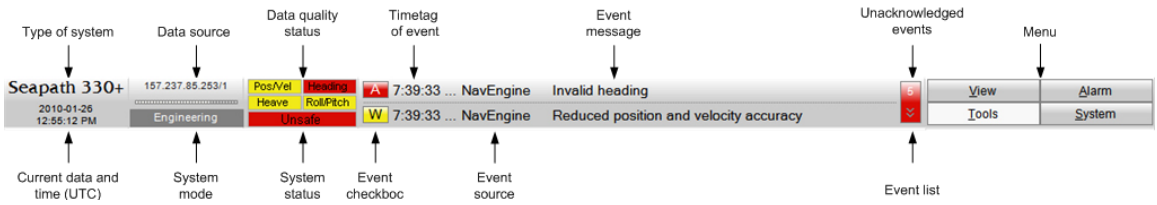



*Figure 36 Top bar*

### System modes

Seapath has three system modes, indicated in the System mode field of the **Top bar**:

**Operation mode** This is the default mode. In this mode it is not possible to launch any external applications, diagnostic tools or reconfigure the system. A password is not required to switch to this mode.

**Configuration mode** In this mode it is possible to change settings related to the connected sensors, applications and system-wide settings.

**Engineering mode** This mode is primarily intended for field engineers during initial installation, fault diagnostics and system-wide reconfiguration.

A password is required to switch from Operation to Engineering or Configuration mode. The password is "stx" and it is not possible to change. The system will return to Operation mode after 3 minutes of user inactivity.

### Data quality status

The Seapath has the following four data quality status indicators:

- Horizontal position and velocity
- Heave
- Roll and pitch
- Heading

The colour codes are:

- Green; normal
- Orange; reduced performance
- Red; invalid data
- The quality status information output on serial lines or Ethernet is the same as indicated on the data quality status indicators.

### System status

Seapath has three system states. The system status describes the position integrity level, and is indicated in the status field of the **Top bar**. The background colour of this field helps indicate the system status. The system states are:

Safe


Caution


Unsafe


→ *For more information about integrity, see section 5.5*

### Events

Three types of events may appear:

- Information messages
- Warnings
- Alarms

An event message is acknowledged by clicking in the **Event** check box. When an event is acknowledged, it disappears from the **Event list**. However, the event can still be viewed in **Alarm history** under the **Alarm** menu.

### Application menu

The four menu buttons located to the far right on the **Top bar** constitute the application menu:

- View
- Alarm
- Tools
- System

The various menus have a drop-down list offering various operational and visual options.

## 5.3 Sky view

The **Sky view** display shows which satellites the system is tracking and using in the position computation. The satellites are presented according to satellite geometry. The grey outer circle represents the elevation mask. Satellites under the set elevation mask are marked grey. The satellite azimuth angle is according to the north-south axis.

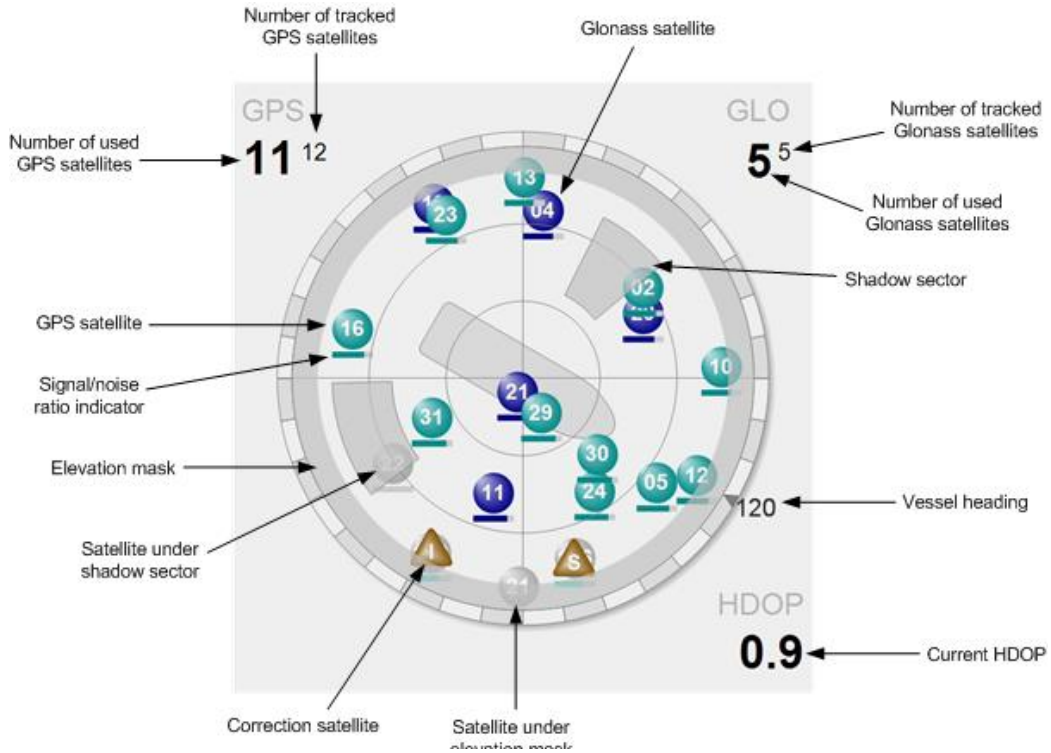



*Figure 37 Sky view*

In the upper left corner, the number of GPS satellites tracked and used in the position solution is presented. In the upper right corner, the number of GLONASS satellites tracked and used in the position solution, is presented.

GPS satellite | GLONASS satellite | SBAS satellite | Rejected satellite | Disabled satellite | Correction satellite

*Figure 38 Satellite colours*

Satellites marked grey are disabled as they are not used directly in the position fix, e.g. satellites under the elevation mask or satellites under a shadow sector.

The bar(s) at the bottom of each satellite represents the signal-to-noise level for the satellite, and the longer the bar, the stronger the signal.

The upper bar represents the L1 signal-to-noise level, while the lower bar represents the L2 signal-to-noise level.

*Figure 39 Satellites with two signal-to-noise bars*

When the mouse cursor hovers over a satellite symbol, a tooltip will appear with the status of the satellite including azimuth, elevation, L1/L2 signal-to-noise ratio and differential correction availability.

If the vessel has a gyro interfaced, the display shows the vessel's true heading.

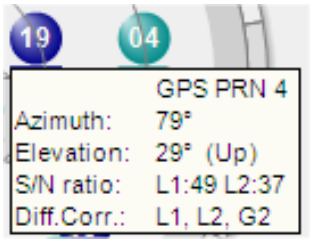



*Figure 40 Tooltip for GPS satellite with corrections*

The shadow sectors have no effect on calculations but will assist in explaining why some satellites are not used in the position fix.

The **Sky view** is configured in the **Sky view** tab in the **Operator software configuration** dialog. It is possible to enable or disable the correction satellites, the signal bars, the track plot and the shadow sectors.

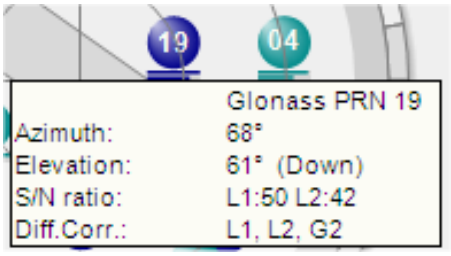



*Figure 41 Tooltip for GLONASS satellite with corrections*

## 5.4 DGNSS views

There are two DGNSS views, **DGNSS age** view and **DGNSS status** view. Both views indicate the status of the available correction links.

All links are indicated using green colour if correction data are received, red if *no* data are received through that link, or light grey if the link has been disabled for some reason.

Status of up to 9 correction links may be displayed. Each link is identified by its name as defined in the Configuration file. The number of reference stations used in the position calculation and the number of reference stations available are indicated for each correction link.

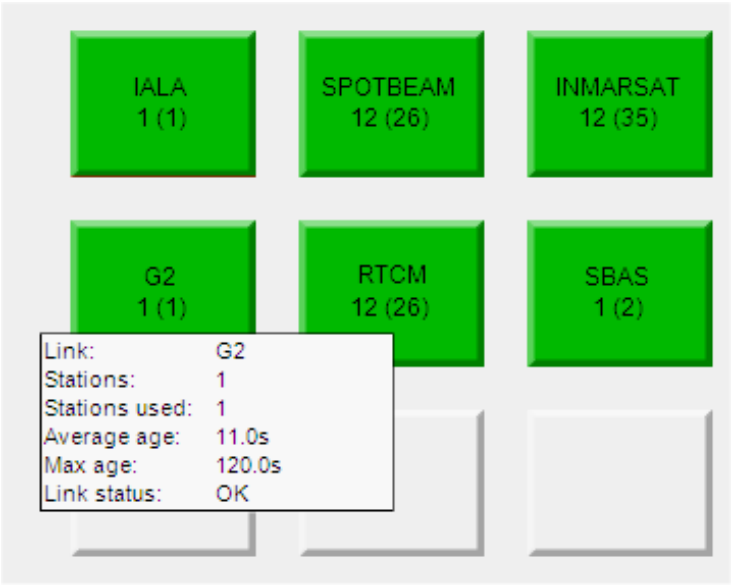



*Figure 42 DGNSS status view*

A tooltip is displayed when dragging the mouse over a correction link. The tooltip displays information on the specific correction link, as seen in Figure 42.

The **DGNSS age** view, as seen in Figure 43, presents each link as a circular button and presents a bar that indicates the quality as the age of the corrections received through that link. If a bar is filled green, the correction signals are newer. The older the signals are, the shorter the bar is.

If the bar is grey, the age of the corrections has exceeded the maximum age, and the corrections from the link are not in use. The maximum age for using differential corrections is set in the **Configuration** view.

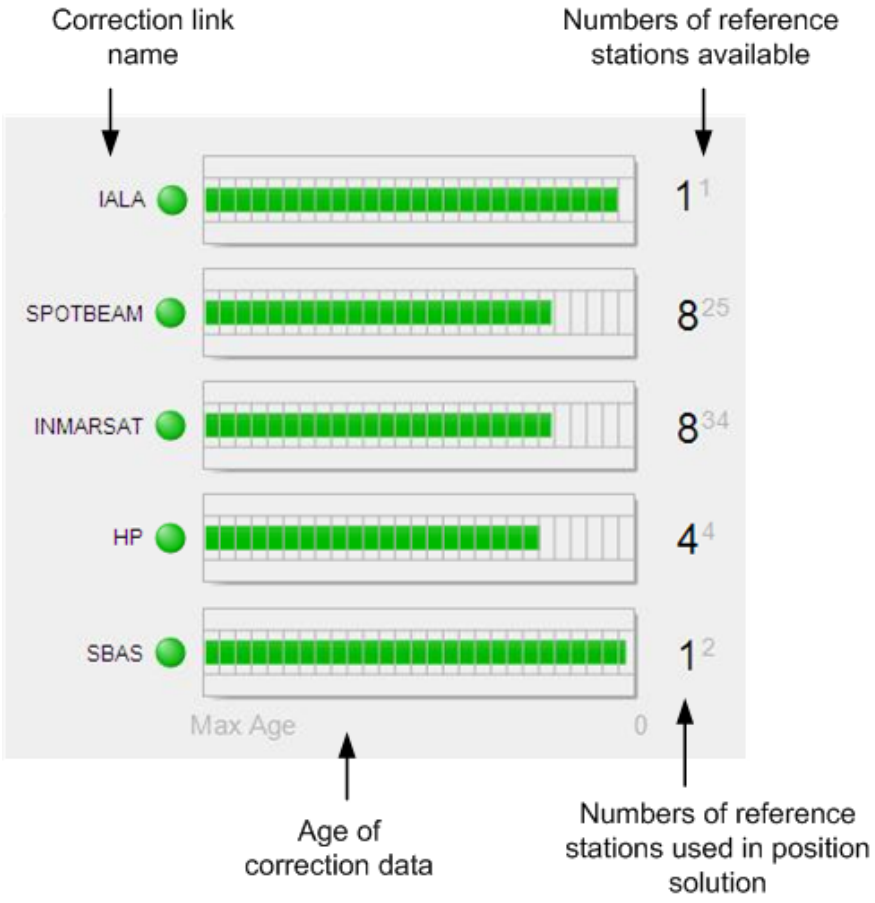



*Figure 43 DGNSS age view*

When clicking on one of the link buttons, the **DGNSS Monitor** appears. This view lists details of all available reference stations from all correction links.

## 5.5 Integrity view

The **Integrity** view indicates the position integrity of the system position according to the IMO requirements to positioning equipment based on the RAIM exclusion and detection algorithm implemented. The integrity indication for different position accuracy levels is expressed in three states (Safe, Caution and Unsafe) according to the requirements. The different states are indicated with colours (green, yellow and red) on the vertical bar in the view.

Part of the view is also an error ellipse that describes the position quality and the geometry of the position solution. The position accuracy level is configurable from the setup file (the value is displayed as the outer circle on the axis). Default value is 10 m.

The system integrity value is often referred to as the horizontal external reliability. It gives an indication of how large a horizontal position error might be, at the condition of an arbitrary undetected satellite failure.

**Safe (green)** indicates that the system accuracy is below the selected accuracy level and that a single satellite failure cannot make the actual horizontal position error exceed the selected integrity limit (95 % confidence level).

**Caution (yellow)** indicates that the system accuracy is below the selected position accuracy level but a single satellite failure might not be detected. If such a satellite failure is detected, the actual horizontal position error might exceed the selected integrity limit (95 % confidence level). With only four satellites (three when height aiding is chosen), there is no way to detect a satellite failure, and the system will always be in the state Caution or Unsafe. The expected accuracy and HDOP might still be reasonably low.

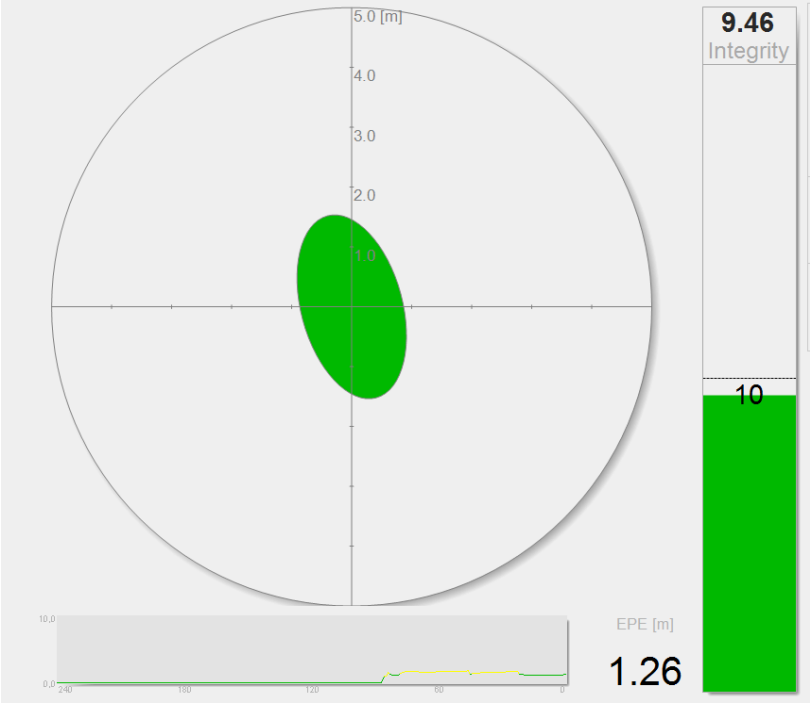



*Figure 44 Integrity view*

**Unsafe (red)** indicates that the system accuracy is above the selected accuracy level (95 % confidence level).

## 5.6 Compass view

The **Compass** view shows the position of the vessel at NRP, the vessel heading, COG and SOG.

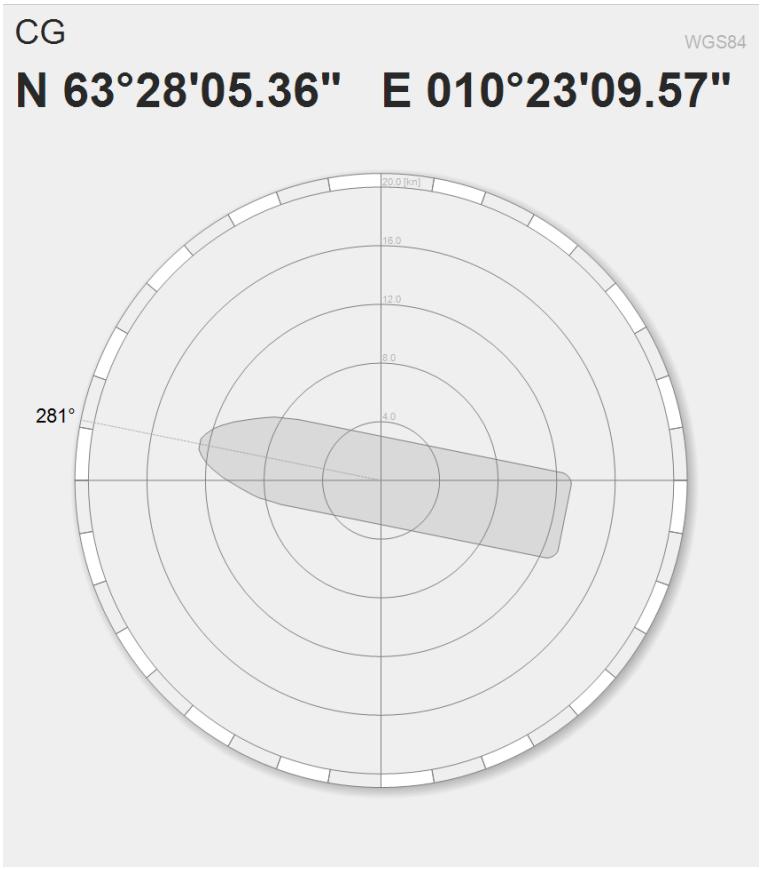



*Figure 45 Compass view*

## 5.7 Motion Data view

The main function of the **Motion Data** view is to give information about the speed and heading of the vessel.

Longitudinal and transversal speed (SL and ST) are presented together with arrows indicating forward/aft and port/starboard directions. The arrows and the vessel's course over ground (COG) are not displayed if the speed over ground (SOG) is less than 0.1 m/s.

Also the vessel roll, pitch, heave and rate of turn (ROT) are shown in this view.

*Note* *The displayed speed values apply to the NRP only even if the position is displayed for other measurement points.*

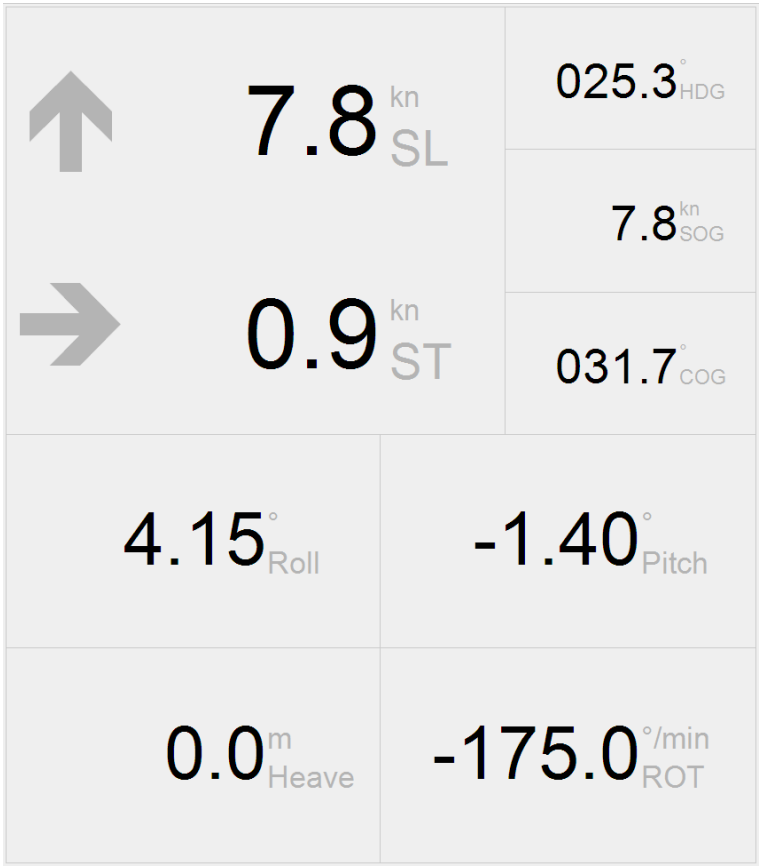



*Figure 46 Motion Data view*

## 5.8 Time Series view

This view plots roll, pitch, heave and heading as time series. The user may zoom in parts of each plot. The colour of the time series indicates the data quality. In the heave time series both real-time heave and delayed heave are presented in the same time series. Therefore the heave time series is always 2 minutes delayed in time in order to be able to present both measurements in the same curve and for the same sample.

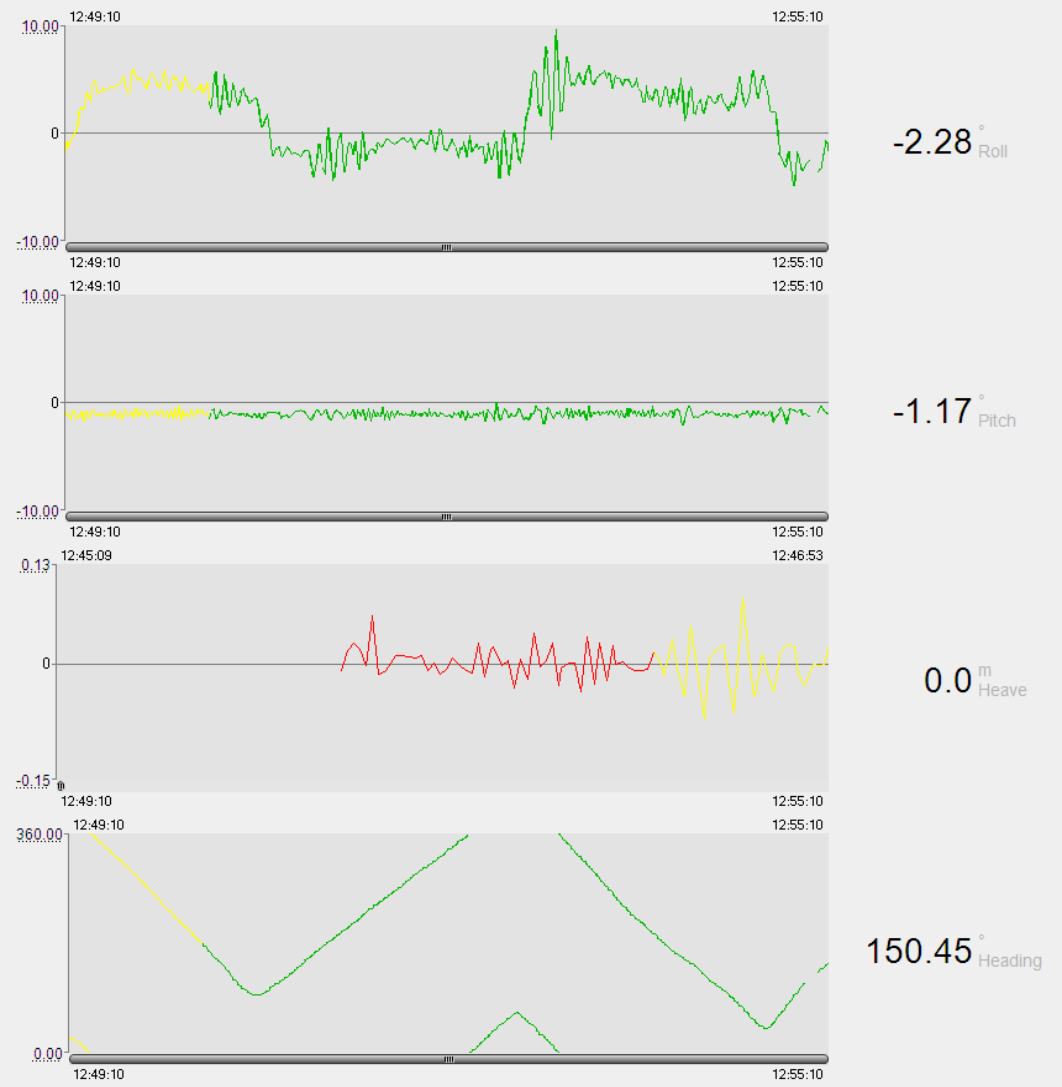



*Figure 47 Times Series view showing data for roll, pitch, heave and heading*

## 5.9 View menu

The **View** menu is a part of the Application menu located to the far right on the **Top bar** and holds the Display mode, View, Display format and Bars features.

### 5.9.1 Display mode

The Display mode controls the selection of colours used by the HMI. Click a menu item to select the desired mode.

**Day bright** Will give the brightest colour combination.

**Day white** This is the recommended colour combination for daylight use.

**Day black** This colour combination uses bright colours, but has a dark background.

**Dusk** This colour combination is intended for use during dusk or dawn.

**Night** This is a special palette with very low contrast on black background, intended to be used during night without weakening the night sight of the system operators.

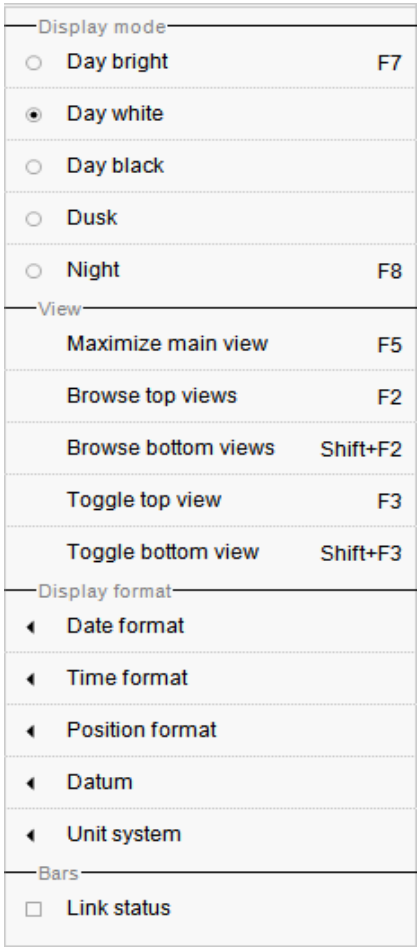



*Figure 48 View menu*

Press **F8** to enter Night mode.

Press **F7** to browse through the non-night colour palettes. If clicked when in **Night** mode, **Dusk** will be selected.

*Figure 49 Dusk mode*

*Figure 50 Day black mode*

## 5.10 Tools menu

The **Tools** menu shows a configurable list of tools serving various diagnostic purposes.

This manual describes a typical set of tools defined for Seapath, and is subject to change without notice.

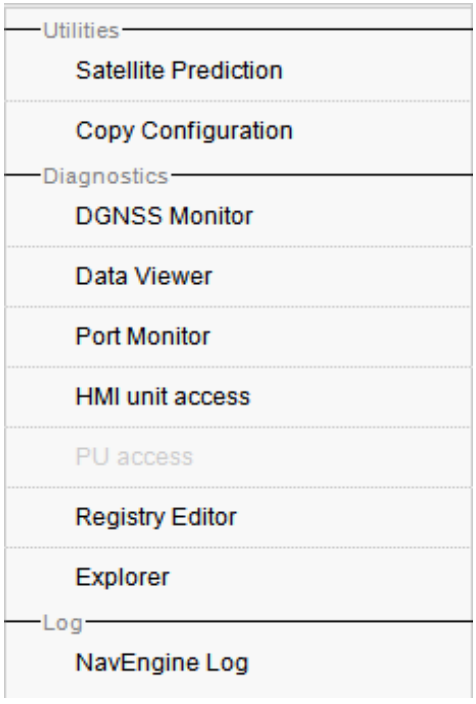



*Figure 51 Tools menu*

### 5.10.1 Utilities

**Satellite Prediction** A tool which displays number of satellites and satellite geometry for a defined position and period.

**Copy Configuration** A tool that copies all relevant configurations into a zip archive.

### 5.10.2 Diagnostics

A tool which shows information about available reference stations.

| | |
|---|---|
| **DGNSS Monitor** | A tool which shows information about available reference stations; see section below for more information. |
| **Data Viewer** | An application for providing raw data views to ease system verification and diagnostics. |
| **Port Monitor** | An application which displays the data traffic on all serial and net ports. |
| **HMI Unit Access** | Opens the Windows command shell on the HMI Unit. |
| **PU Access** | Opens a MSDOS window on the Processing Unit |
| **Registry Editor** | Opens the Windows Registry Editor. |
| **Explorer** | Opens the Windows Explorer view |

### 5.10.3 Log

| | |
|---|---|
| **NavEngine log** | Opens the Windows Explorer in the root folder for the NavEngine log data. |

## 5.11 System menu

The items of the **System** menu are described below.

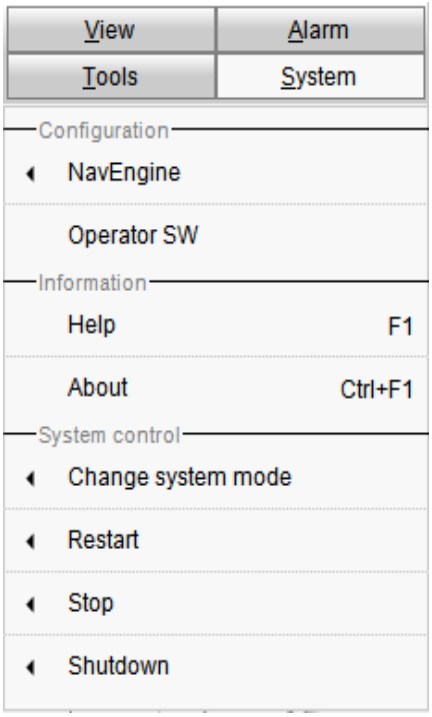



*Figure 52 System menu*

### 5.11.1 Configuration

The **Configuration** section contains two items – **NavEngine** and **Operator SW**.

Selecting **NavEngine** enables a sub-menu were **Standard** or **Advanced** configuration may be selected.

Consult the *Installation Manual* ref [1] for a description on how to configure the NavEngine.

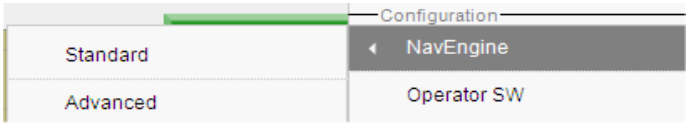



*Figure 53 The NavEngine Configuration menu*

### 5.11.2 Information

The Information section contains the Help and About dialogs.

**Help** Displays a Quick Help dialog presenting some basic help information.

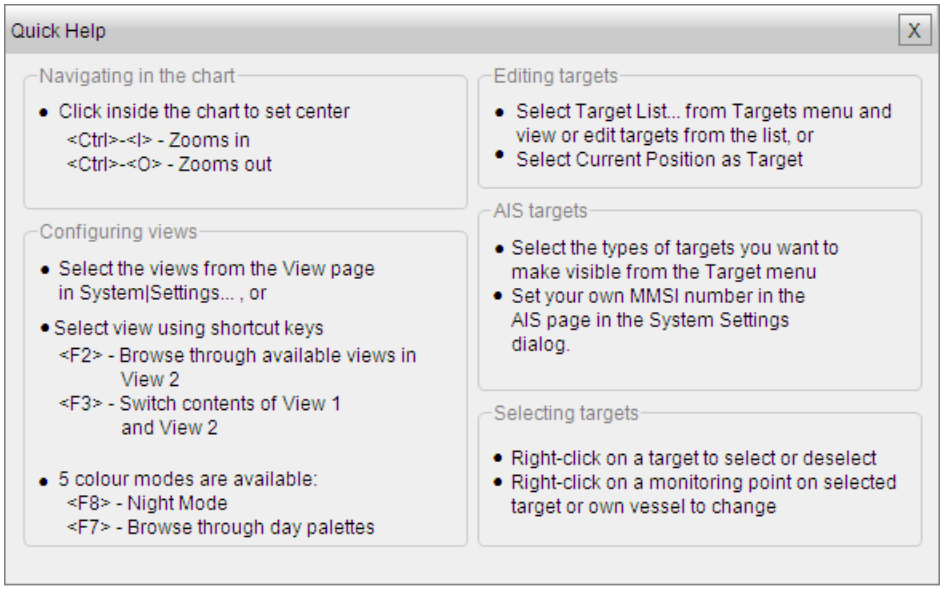

Quick Help
X
Navigating in the chart
• Click inside the chart to set center
<Ctrl>-<I> - Zooms in
<Ctrl>-<O> - Zooms out
Configuring views
• Select the views from the View page in System|Settings... , or
• Select view using shortcut keys
<F2> - Browse through available views in View 2
<F3> - Switch contents of View 1 and View 2
• 5 colour modes are available:
<F8> - Night Mode
<F7> - Browse through day palettes
Editing targets
• Select Target List... from Targets menu and view or edit targets from the list, or
• Select Current Position as Target
AIS targets
• Select the types of targets you want to make visible from the Target menu
• Set your own MMSI number in the AIS page in the System Settings dialog.
Selecting targets
• Right-click on a target to select or deselect
• Right-click on a monitoring point on selected target or own vessel to change

*Figure 54 Quick Help dialog*

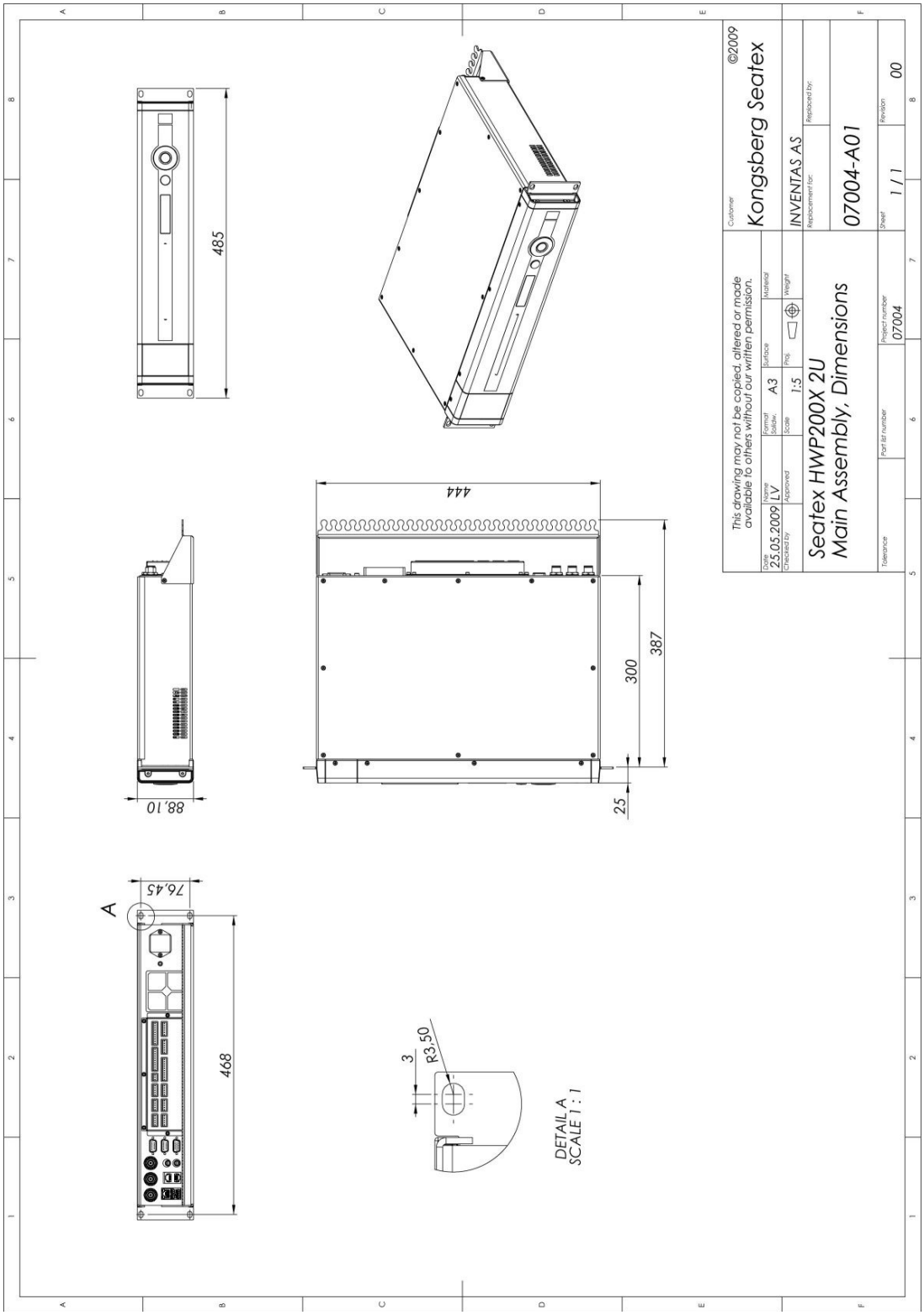
**About** Presents the **About** dialog which contains various information about the system such as contact, software version and equipment information.

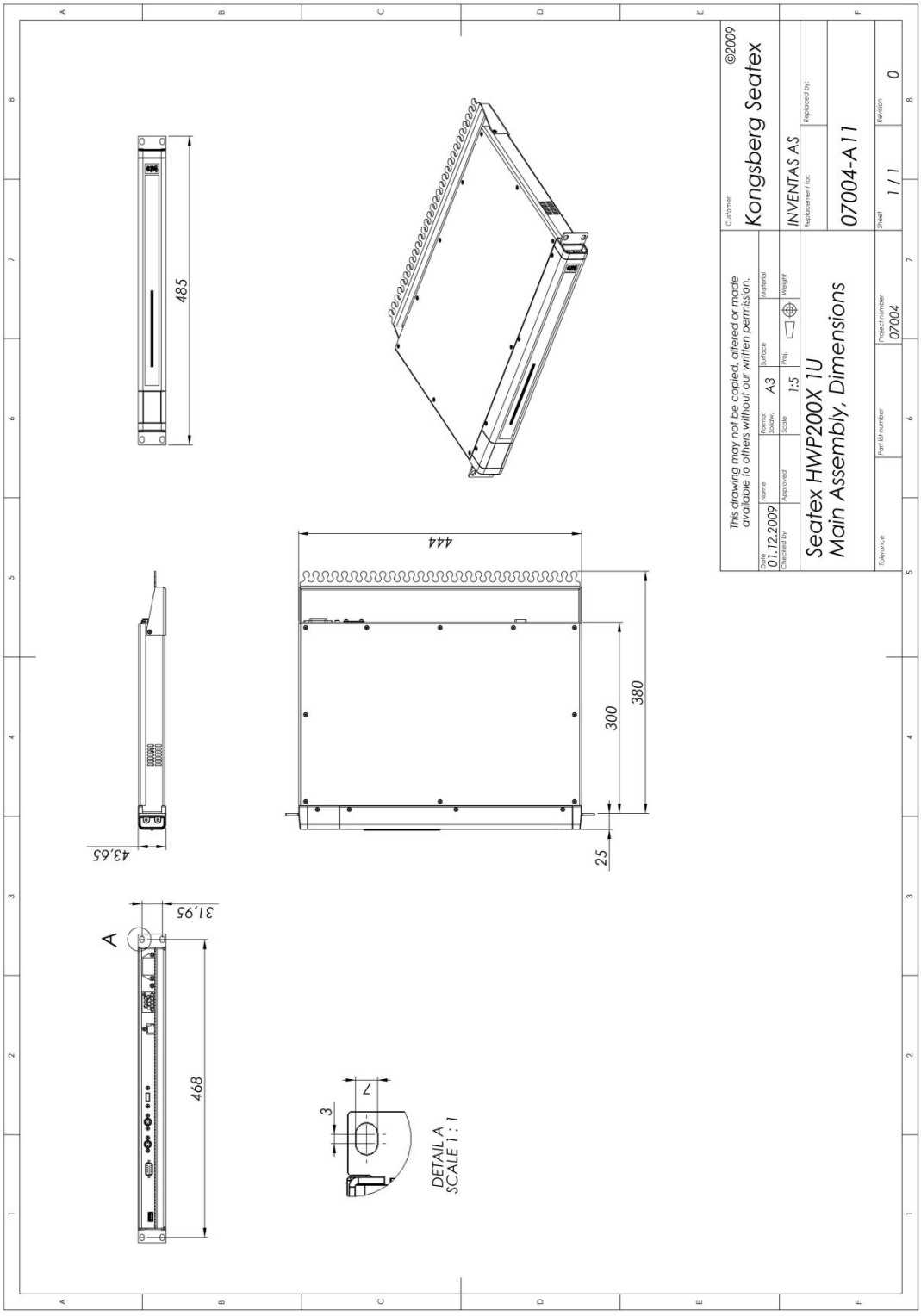
# 6 DRAWINGS

This section contains outline drawings, showing mechanical dimensions of the Processing and HMI Units, the GNSS Antenna Bracket and Holder, the MRU 5 and its mounting bracket, the MRU junction box, the GNSS antennas and the 6U cabinet.

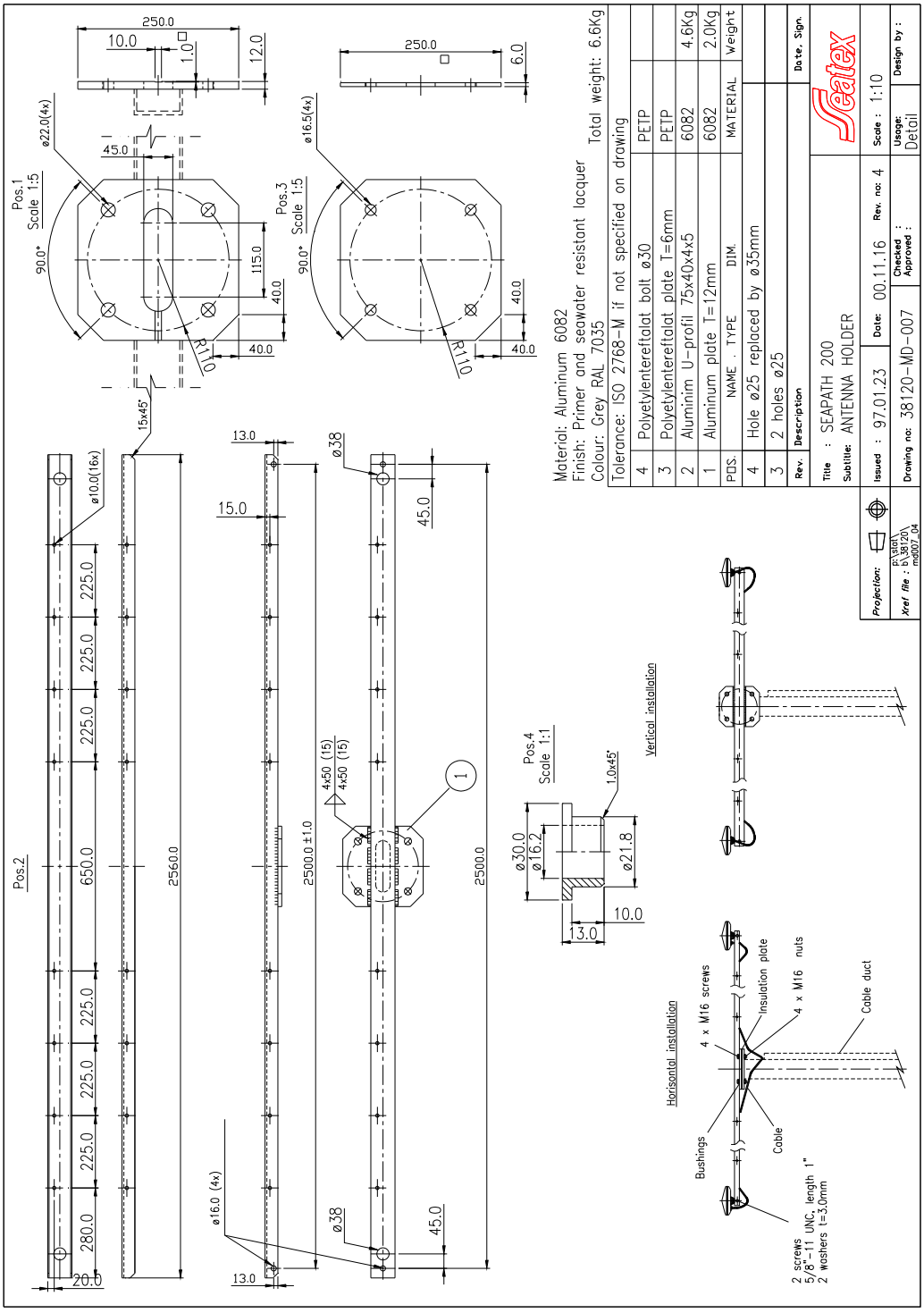
*Note* *The drawings are note to scale. To scale drawings are available on request.*

## 6.1 Processing and HMI Units

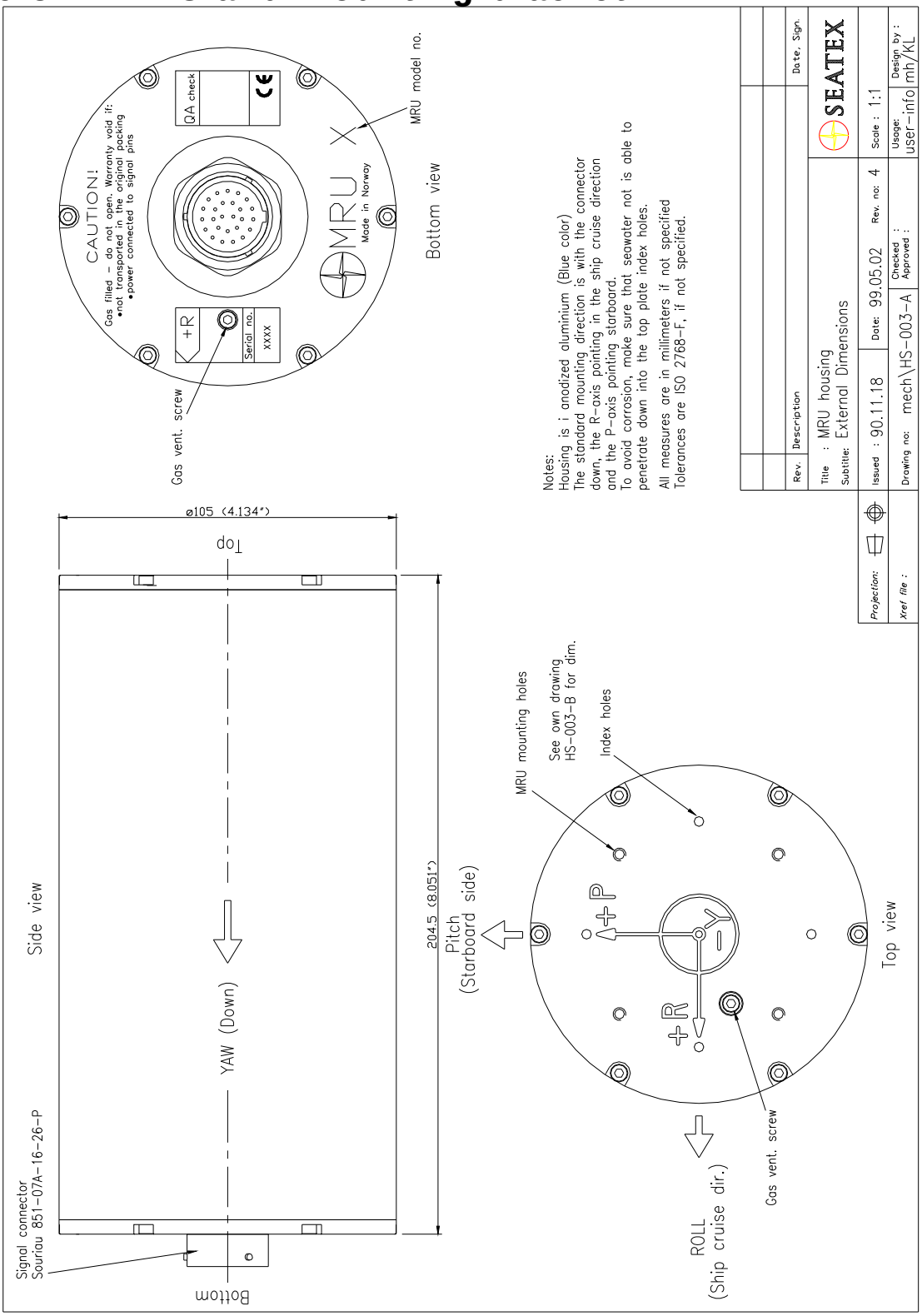


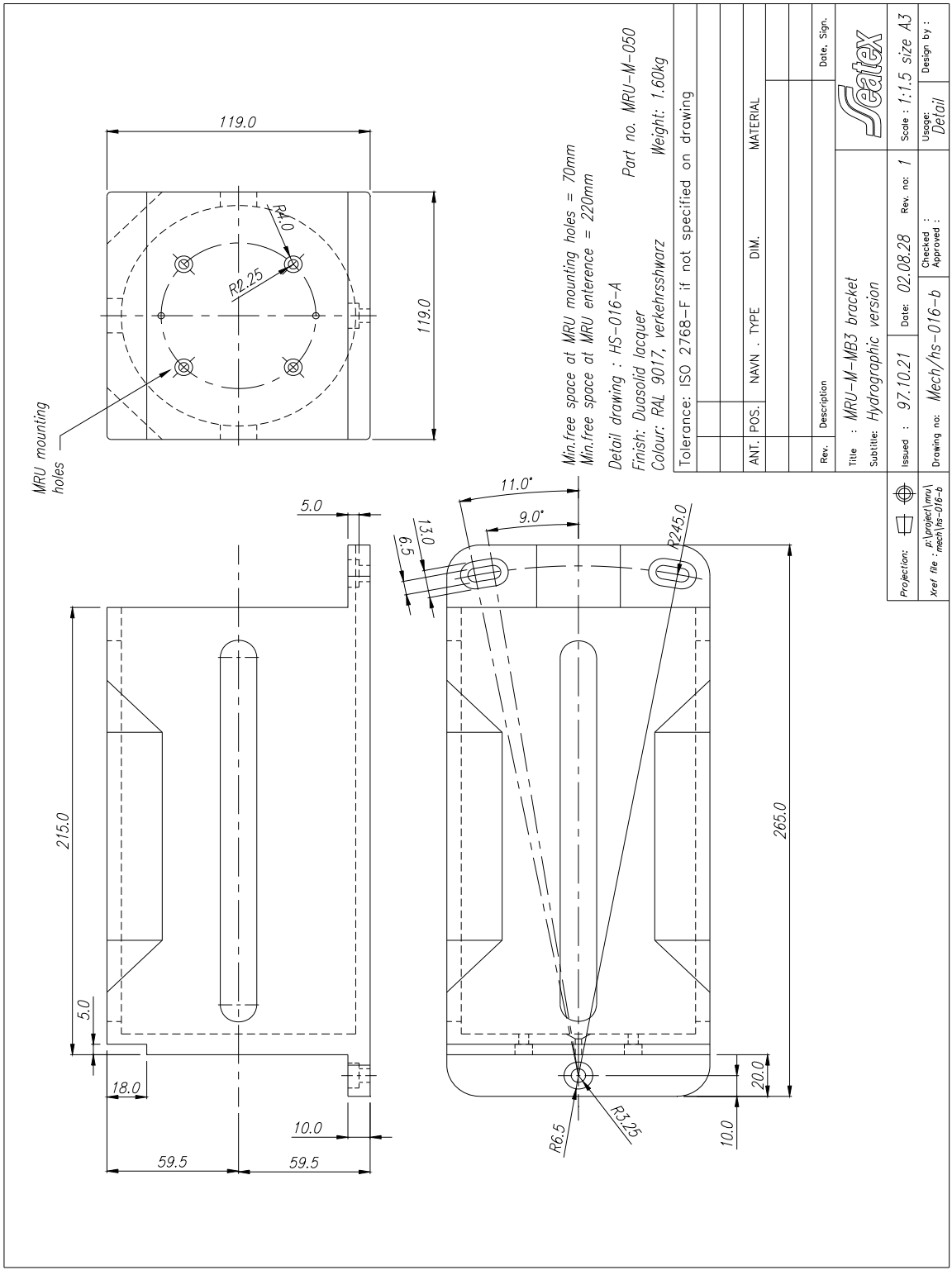

485
444
380
300
25
43,65
31,95
468
A
DETAIL A
SCALE 1 : 1
3
7
©2009
Kongsberg Seatex
INVENTAS AS
07004-A11
Seatex HWP200X 1U
Main Assembly, Dimensions
This drawing may not be copied, altered or made available to others without our written permission.
Customer
Date
01.12.2009
Checked by
Approved
Name
Format
Scale
A3
1:5
Surface
Proj.
Material
Weight
Replacement for:
Replaced by:
Tolerance
Part list number
Project number
07004
Sheet
1 / 1
Revision
0

## 6.2 Antenna bracket

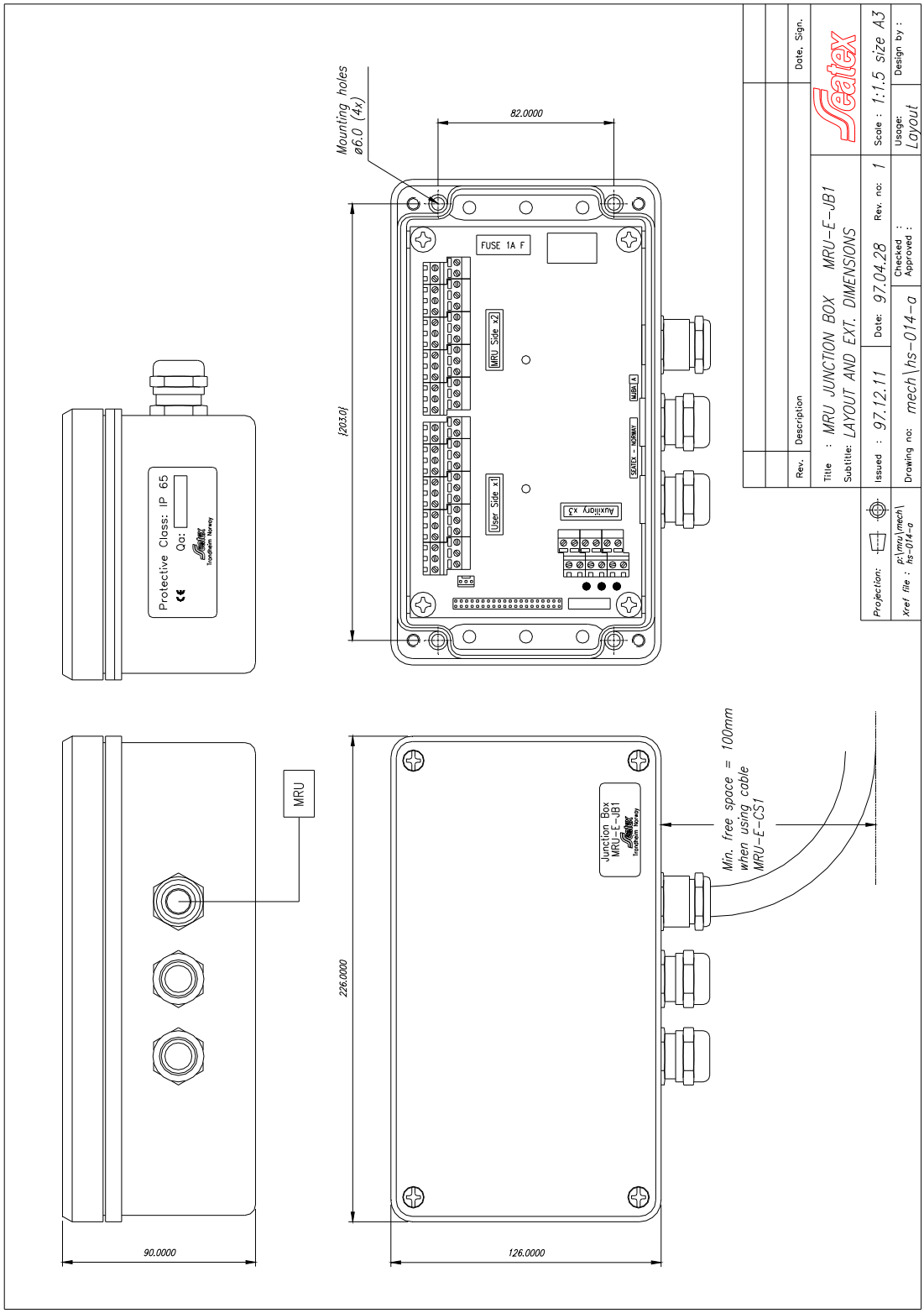

Material: Aluminum 6082
Finish: Primer and seawater resistant lacquer
Colour: Grey RAL 7035
Total weight: 6.6Kg
Tolerance: ISO 2768-M if not specified on drawing
4 Polyetylentereftalat bolt ø30 PETP
3 Polyetylentereftalat plate T=6mm PETP
2 Aluminim U-profil 75x40x4x5 6082 4.6Kg
1 Aluminum plate T=12mm 6082 2.0Kg
POS. NAME . TYPE DIM. MATERIAL Weight
4 Hole ø25 replaced by ø35mm
3 2 holes ø25
Rev. Description Date. Sign.
Title : SEAPATH 200
Subtitle: ANTENNA HOLDER
Issued : 97.01.23 Date: 00.11.16 Rev. no: 4 Scale : 1:10
Drawing no: 38120-MD-007 Checked : Approved : Usage: Detail Design by :
Projection:
Xref file : p:\stat\38120\mod\pl_A4
Pos.1 Scale 1:5
Pos.2
Pos.3 Scale 1:5
Pos.4 Scale 1:1
Vertical installation
Horisontal installation
4 x M16 screws
Insulation plate
4 x M16 nuts
Cable duct
Bushings
Cable
2 screws 5/8"-11 UNC, length 1"
2 washers t=3.0mm

## 6.3 MRU and mounting bracket

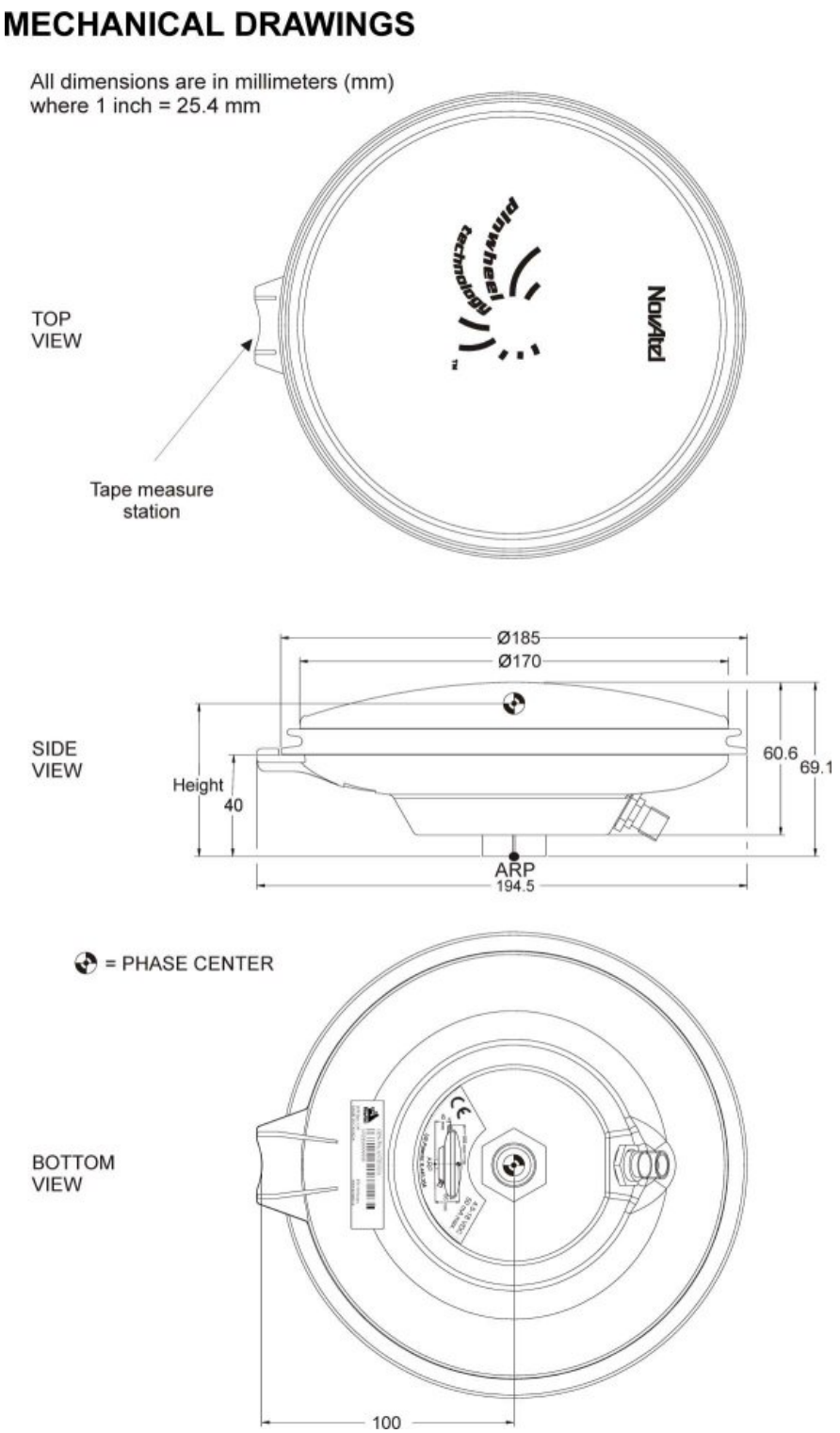



119.0
119.0
R4.0
R2.25
MRU mounting holes
Min.free space at MRU mounting holes = 70mm
Min.free space at MRU enterence = 220mm
Detail drawing : HS-016-A
Finish: Duasolid lacquer
Colour: RAL 9017, verkehrsshwarz
Part no. MRU-M-050
Weight: 1.60kg
Tolerance: ISO 2768-F if not specified on drawing
ANT. POS. NAVN . TYPE DIM. MATERIAL
Rev. Description Date, Sign.
Title : MRU-M-MB3 bracket
Subtitle: Hydrographic version
Seatex
Issued : 97.10.21
Date: 02.08.28
Rev. no: 1
Scale : 1:1.5 size A3
Drawing no: Mech/hs-016-b
Checked :
Approved :
Usage: Detail
Design by :
Projection:
Xref file : p:\project\mru\mech\hs-016-b
5.0
11.0°
9.0°
13.0
6.5
R245.0
215.0
265.0
5.0
18.0
10.0
59.5
59.5
20.0
R6.5
R3.25
10.0

## 6.4 MRU junction box



## 6.5 GNSS antenna mechanical drawings




*Excerpt from GPS-702-GG, GPS-701-GG and GPS702-GG-N User Guide, OM-20000095, rev. 1B, August 7, 2009, NovAtel Inc.*

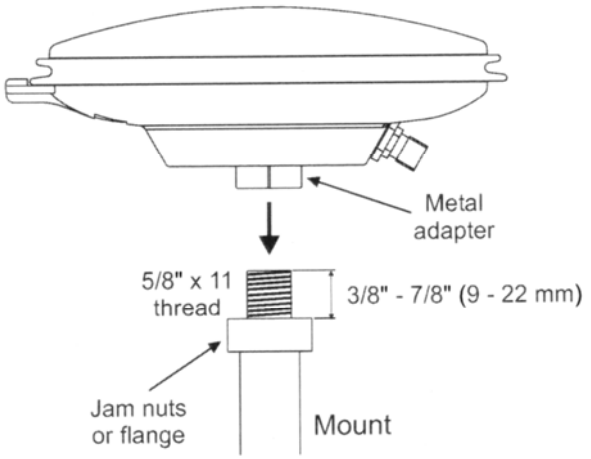
## 6.6 GNSS antenna installation

**Installing the antenna**

After a site has been selected, install the antenna as follows.

1. Verify that the thread on the mount does not extend more than 7/8" (22 mm) to ensure the plastic inside the antenna receptacle is not damaged when the mount is inserted. If it extends further than 7/8" (22 mm), add two jam nuts to shorten the exposed thread, ensuring the nuts are well-tightened.

2. Align the mount thread with the metal adapter on the bottom of the antenna and rotate the antenna clockwise until it is securely screwed to the mount. Using a wrench, tighten the adapter to the mount.

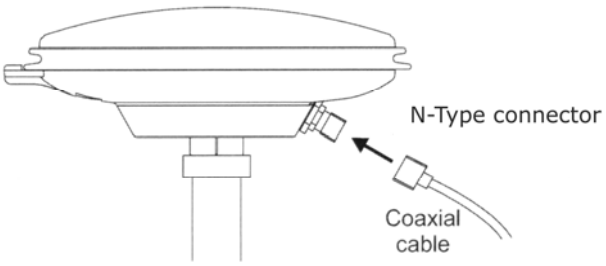



3. Remove the dust cap from the antenna's N-Type connector.

4. Attach the male N-Type connector of the coaxial cable to the antenna's N-Type.

✉ The metal adapter on the bottom of the antenna is fixed in place. Do not attempt to remove it.

5. Attach the end of the coaxial cable to the antenna input port of the receiving device. All NovAtel GNSS receivers provide the necessary power through their antenna RF connectors.

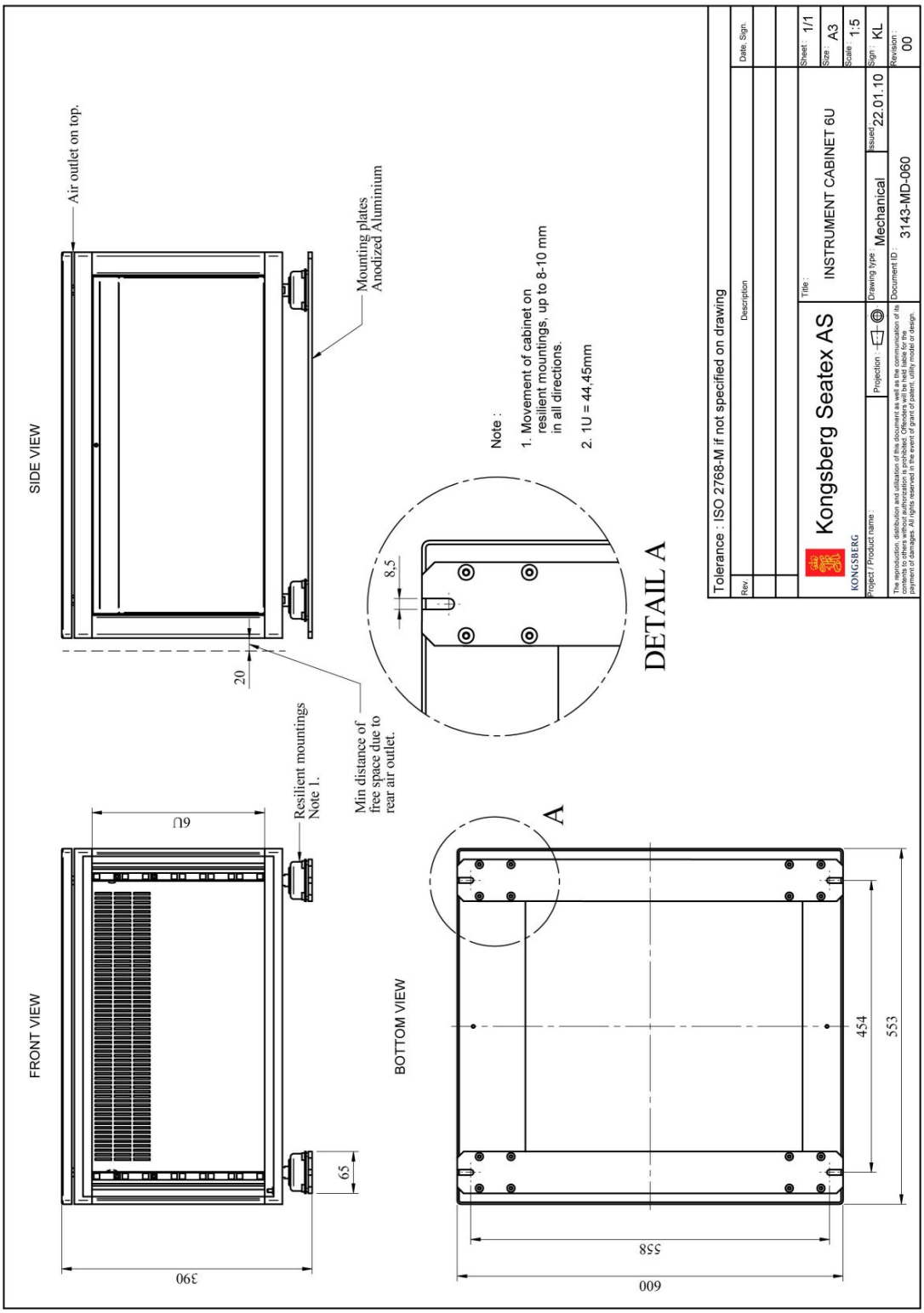


**Antenna care**

The GPS-702-GG-N is designed to withstand the elements, including rain, snow and dust. However, to ensure your antenna performs optimally, keep the radome (top surface of the antenna) clean and brush off any ice and snow. In addition, ensure the N-Type connector remains clean and dry and replace the dust cap when a cable is not connected.

*Excerpt from GPS-702-GG, GPS-701-GG and GPS702-GG-N User Guide, OM-20000095, rev. 1B, August 7, 2009, NovAtel Inc.*

## 6.7 6 U cabinet dimensions



# 7 PART LIST

The basic Seapath 320 version (part no. M300-20) consists of:

| Part no. | No. | Description |
|---|---|---|
| M300-23 | 1 | Seapath 320 Processing Unit including NavEngine software |
| M320-21 | 1 | Antenna Bracket in aluminium, 2.5-metre baseline |
| G060-24N | 2 | Antenna, GPS/GLONASS L1&L2 |
| G071-91 | 4 | Cable, Interconnection, N-M/N-F, 0.5 m |
| M300-04 | 1 | Seapath HMI Unit (1U) with operator software |
| G071-28 | 2 | Cable for power, Processing and HMI Unit, 2.5 m |
| G060-32 | 1 | Monitor, 17" standard LCD, table mount |
| G062-11 | 1 | Keyboard (US layout) |
| G062-16 | 1 | PC mouse |
| MRU-5 | 1 | The MRU 5 sensor |
| MRU-M-MB3 | 1 | MRU wall mounting bracket |
| MRU-E-JB1 | 1 | MRU junction box for flexible connection of MRU to Seapath |
| MRU-E-CS1 | 1 | Cable, heavy duty screened cable with 14 twisted pairs, 3 m |
| MRU-M-SC1 | 1 | MRU transportation box |
| M300-72 | 1 | Seapath 320 Product Manuals |

The Seapath 320 can be delivered with following optional equipment:

| Part no. | Description |
|---|---|
| G070-01 | Cable, GPS antenna, ½" Superflex or similar, length on request |
| G070-03 | Connector kit for GPS antenna cable, ½" Superflex or similar |
| M310-41 | Cable, flexible GPS antenna cable type RG214 Hiflex (max length 40 m) |
| M310-42 | Connector kit for RG214 Hiflex cable |
| M310-62 | Cable, PU to MRU junction box cable, length on request |
| G062-52 | Keyboard with integrated mouse (US layout) |
| G071-21 | Cabinet, height 6U |

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